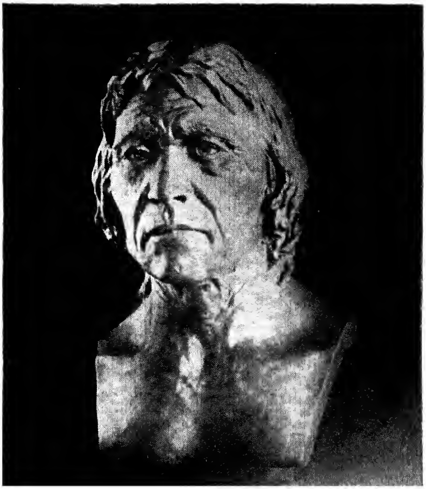
MAN'S LIFE ON EARTH

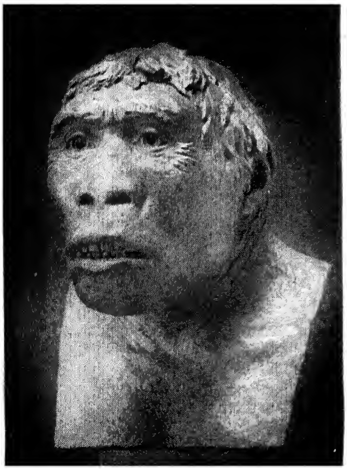
THE MACMILLAN COMPANY
NEW YORK · BOSTON · CHICAGO · DALLAS
ATLANTA · SAN FRANCISCO

MACMILLAN & CO., LIMITED
LONDON · BOMBAY · CALCUTTA
MELBOURNE

THE MACMILLAN CO. OF CANADA, LTD.
TORONTO



C



A

B

PLATE I. RESTORATIONS OF *A*—THE JAVA PRE-MAN, *B*—NEANDERTHAL LOWGRADE MAN, *C*—CRO-MAGNON MAN (FIRST MAN OF MODERN TYPE), RESTORED BY PROFESSOR J. H. MCGREGOR
Pictures obtained from and Printed by Permission of the American Museum of Natural History.

MAN'S LIFE ON EARTH

BY

SAMUEL CHRISTIAN SCHMUCKER, PH. D.

EMERITUS PROFESSOR OF BIOLOGY
STATE NORMAL SCHOOL, WEST CHESTER, PA.
AUTHOR OF "THE MEANING OF EVOLUTION"

New York
THE MACMILLAN COMPANY
1925

Set up and electrotyped,

Published May, 1925.

Printed in the United States of America by

THE FERRIS PRINTING COMPANY, NEW YORK

PREFACE

THIS book claims no originality. It is an attempt to put into form and language intelligible to the general reader, the work of greater men who are too deeply engaged in their researches to be able to talk to the general public. My indebtedness to them I can never repay, except by passing to others as freely as I received it, the knowledge they have given me.

My first and largest indebtedness, in this subject, is to the American Museum of Natural History. If I had done nothing but stand before their cases and study their specimens, their labels and their guide books, my debt would be enormous. But the men of this institution have done much more. Some of them have given me their personal friendship, have given me the accounts of their more technical researches and have helped me to obtain literature and specimens.

To Dr. Osborn's "Men of the Old Stone Age" I owe my first deep interest in this subject, and the inspiration to go further. From the publications, in journals or in book form, of Dr. McCurdy, Dr. Wilder, Dr. Hrdlicka and others I have gained much. Dr. McCurdy's "Human Origins" is an excellent contribution to the subject. Unfortunately for me, it came too recently for me to have made as much use of it as I should have liked.

There is one man who has done more for me in this matter than any other to inspire me and to fill me with

a desire always so to state my beliefs as to recognize the possibility that I am mistaken, and the other man right. This man is Dr. William K. Gregory, of the American Museum of Natural History, whose accuracy of scholarship, devotion to truth and modesty in estimating his own value exceed that of any other scientist with whom I have had the blessing of contact.

Nothing I have said, however, should serve to shift to these excellent men the blame for any of my mistakes of statement or of position.

The plates illustrating this book are used through the kind permission of the American Museum of Natural History and of the Lippincott Company. The figures in the text are drawn by my wife, to whose untiring assistance and kindly stimulus, are due most of the value of what books I have written. These figures in the text are either from my own specimens or are redrawn from the publications which have made them the common possession of the science.

TABLE OF CONTENTS

Chapter IV

WHAT ARE EOLITHS

Chapter V

DATING THE WORK OF PRIMITIVE MAN

Chapter VI

LOW BROW STONE AGE MAN

Chapter VII

HIGH BROW STONE AGE MAN

CHAPTER VIII

THE ICE AGE

CHAPTER IX

THE TRANSITION TO MODERN TIMES

CHAPTER X

THE NEW STONE AGE BEGINS

CHAPTER XI

THE GROWTH OF INDUSTRY

Chapter XVI

MAN'S BODY A WITNESS

Chapter XVII

THE RELIGIOUS DIFFICULTY

LIST OF ILLUSTRATIONS

Plates

Figures in Text

INTRODUCTION

In the middle of the last century came a series of events in the scientific world which startled the mind of those not trained in the sciences more perhaps than men had ever been startled before by the disclosure of a new truth. Earlier discoveries had been quite as remarkable, but they only filtered slowly into the general knowledge, and hence a large part of even the intelligent world was slow coming to any realization that the revolution in human thinking was going on. Such a revolution came when Copernicus received into his hands on his death bed, the book which first clearly proved that the earth was small compared with the sun, and very far from it, and moved about the sun. The church denied it, and for most of such part of the lay world as heard about it, this denial was enough to discredit it. When later Galileo, with his lead organ-pipe, furnished with a convex lens at the far end and a concave lens near his eye, and having not much more power than a fine field glass has today, saw the moons of Jupiter and the phases of Venus, and confirmed the saying of Copernicus, the church made him say that he had been mistaken—and again for a time all was quiet.

But no such silencing of men was possible when Darwin's paper and Wallace's were read on the same night at a meeting of the Linnaean Society. By one of the most remarkable coincidences in the history of human thought, both men asserted the same idea of evolution, and both

suggested the same explanation of how such a result had been brought about.

Darwin's work was the more carefully done, and involved many years of definite investigation directed exactly to that problem. Wallace's paper had been thrown together rather hastily, and was the result of his thinking over a long series of observations, made without any such theory in view. There is no more generous story in the history of human thought than the magnanimity with which Wallace yielded to Darwin the credit of the great idea.

Not that the conception of evolution itself was new. It had cropped out in human thought repeatedly since the time of the ancient Greeks, whose myriad mind seemed to catch a glimpse of most of the truths that have been established since. But no earlier scientists had ever had a wide enough basis of observation, on which to found an unanswerable argument.

The next year saw the publication of Darwin's "Origin of Species." When, at the beginning of the twentieth century, Dr. Lyman Abbott, of the *Outlook,* asked ten men prominent in letters, in education, in public life—that each of them name the ten books, written in the preceding century, that had done most to form the minds of thinking men, Darwin's "Origin of Species" was the only book which was on every list. Especial significance is added to this judgment when we see who the men were who formed it. All of them stood high in the esteem of the thinking world. They were Principal Fairbairn of Oxford University, President Tucker of Dartmouth, President Hadley of Yale, President Hall of Clarke University, President Hyde of Bowdoin, James Bryce, whose

"American Commonwealth" had gained for him great honor in this country, and who was later to come as Ambassador from England; Dr. Henry Van Dyke of Princeton, Dr. Gordon of Old South Church, Boston, Thomas Wentworth Higginson, and last, but by no means least in the esteem of the American people—Edward Everett Hale.

This new idea did not need to filter slowly into the consciousness of the thinking world, as did the work of Copernicus or Galileo. Communication had become easy. Newspapers and journals were everywhere, and every thinking man could, and did, read and write. So the knowledge of this newly confirmed, though old, idea ran quickly through the intellectual world.

It is quite natural, and indeed commendable, that the religious world, and most of the thinking world of England was religious, should have combatted an idea that ran so contrary to what seemed to them the plain teaching of the Bible which they loved, and which was the chart and compass of their life.

There had of course been more or less of the critical study of that Bible itself which, if it had been generally accepted, would have made the new biological idea of evolution less revolutionary. But the new knowledge about the Bible had not yet produced enough effect to make the acceptance of the evolution idea easy. At that time a very considerable number of the scientists of England were clergymen, and most of the rest were physicians. Science had hardly as yet become a profession of itself, yielding a living income. It was the "hobby" of intelligent men of independent means or of some other occupation which yielded them a living.

These clergymen rose nobly to the defense of their faith. But enough of them were also sufficiently trained in science to make it easy for them to appreciate at their full value the arguments adduced in favor of evolution by Darwin, Wallace, Huxley, and the others who were steadily added to that great group.

One by one these clergymen began to come over, not yielding their faith, but believing that instead of undermining the great foundations of religion, the new attitude was only running counter to some of the conceptions of religious people, and that in reality it was giving a new stability and dignity to the Faith. There was for a time much bitterness on both sides. Some of the clergy said sharp things about the evolutionists, and the latter sometimes retorted in kind, particularly Huxley, who gained for himself the nickname of the Bull Dog of the Evolution movement. But gradually the battle grew less acrimonious on both sides, and signs of a better understanding were evident. When, twenty-three years after the publication of this great work, Darwin's frail heart, which had only served him through his long work by the utmost care of his health, and by the most unselfish assistance from his devoted wife, ceased to beat, a great hush went over England. There was general recognition of the fact that one of England's greatest minds had passed away. There is one honor which perhaps is the highest this world has yet devised to recognize the worth of a departed great man. One mausoleum holds more of the world's renowned dead than any other.

With the immediate consent of the broad-minded Dr. Bradley, Dean of Westminster, who, though abroad at the time, telegraphed his permission, Darwin's body was

laid away in Westminster Abbey. The pall-bearers on this occasion were a remarkable group: Alfred Russel Wallace and Huxley, naturally, the well-beloved Canon Farrar, and, interestingly, James Russell Lowell, then our Minister to the Court of St. James. The church finally took to her bosom the child she had at first been tempted to disown, but whom she had come better to understand.

Meanwhile the evolution idea was spreading to the other sciences. Men found it a fertile principle, almost wherever they applied it. It began to dominate the treatment of nearly every type of study. The idea that to understand anything, the most satisfactory foundation is to know how it came to be what it is, began to underlie the treatment of psychology, biology, history, of economics, of astronomy, of physics, and of chemistry.

To attempt to exclude from our institutions of learning all that owed its spirit to Darwin's idea would be to wipe out the great bulk of modern scientific literature.

In 1909 his home University of Cambridge invited a group of scientists to join in the making of a volume of essays commemorating the hundredth anniversary of Darwin's birth and the fiftieth of the publication of his "Origin of Species."

In this volume members of the various departments of the University joined with learned men from many outside institutions, each of them telling the influence of Darwin's idea on his own line of work.

The table of contents of this volume is a remarkable roster of great names. These men all credited to Darwin the leadership in the great modern scientific movement. Many of them did not agree with all he had written, of course, but they did with his underlying idea, that in all

science, as in all history, the present is the child of the past and the parent of the future. The plants of today are the altered plants of yesterday. All the plants that ever lived are more or less distantly related to each other. Many kinds in the past died out; others were more or less gradually transformed into the plants of to-day.

The animals which today are gathering their food and hunting their mates, are the descendants of those who in earlier geological ages in very different forms and under very different circumstances made their struggle for existence.

Nor can the anthropologist doubt that the method by which God made these plants and animals is the method by which he made man himself.

There is a story which, in the past history of science, has repeated itself again and again. A great mind puts forth a great idea. It is scouted at first, slowly wins its way, and is finally generally accepted by those familiar with that science.

Then begins a new stage. It is seen that the great idea has many sides to it, and each man starts working on one side of the problem. He works deep into its details and creates a subordinate branch of science, with its own narrow field and its own special language. These men accumulate such an abundant and varied mass of material that no one man can be familiar with it all. Each of these men finds that the great man who founded the science of course did not percieve all its implications, perhaps even misapprehended them. The lesser man does not hesitate to point out where his predecessor was wrong, nor does he feel it necessary to say that with the main body of the leader's thought he may be in entire sympathy.

Darwin made two great contributions to modern thought. First, and by far the most important, he, first of all men, persuaded the general scientific world of the fact of evolution; that the plants of to-day are the altered plants of yesterday; that the animals of to-day are the altered animals of yesterday; and that man is no exception.

This is what the general man means when he speaks of Darwinism. But this is not what the biologist means when he speaks of Darwinism.

Darwin's second contribution was the idea that the principle which will most fully account for this evolution is what he called "Natural Selection," what Wallace called "The Struggle for Existence," what Spencer called "The Survival of the Fittest." This is what the biologist means by Darwinism.

It was this difference in the meaning of the word "Darwinism" which caused a great misunderstanding on the part of the public some few winters ago.

To the meeting of the American Association for the Advancement of Science, held in Toronto, came Dr. Bateson, of Cambridge University, a really distinguished student of biology, particularly of that subdivision of biology which we call Genetics, and which has for its field the study of inheritance by animals and plants of the qualities which come to them through their parents. At this meeting Bateson expressed it as his opinion that Darwinism propounded more problems than it solved.

Immediately the newspaper reporters, having in their minds the first definition of Darwinism, sent the news abroad that a great English scientist had abandoned evolution and disowned Darwin. Every biologist knew perfectly what Bateson meant. But the country was so much

disturbed about evolution at the time that our scientists dreaded the effect of the misunderstanding which would result from Bateson's announcement. A number of them begged him to explain his meaning through the press, but his reply was in substance that he was speaking to an audience of scientists and that they knew perfectly what he meant. He declined to add any explanation of his position which he said was perfectly clear. And so it was to the members of the association. But after a while he realized that he had been misunderstood by the public and that the consequences of that misunderstanding were far from negligible. Hence he later said in *Nature*, the English scientific journal, "Though no one doubts the truth of evolution, we have yet no satisfactory account of that particular part of the theory which is concerned with the evolution of species in the strict sense. The purpose of my address was to urge my colleagues to bear this part of the problem constantly in mind. When such confessions are made, the enemies of science all see their chance. If we cannot declare here and now how species arose they will obligingly offer us the solution with which obscurantism is satisfied. Let us then proclaim in precise and unmistakable language that our faith in evolution is unshaken. Every available line of argument converges on this inevitable conclusion."

At the next annual meeting of the American Association for the Advancement of Science, held in Boston in December, 1923, a committee of that body undertook to make clear the attitude of this, the largest scientific body in America, and one of the largest in the world.

Their formulation of the position of the modern

scientist on this matter was adopted, I think without expressed dissent by the council of that body.

"*Inasmuch* as the attempt has been made in several states to prohibit in tax-supported institutions the teaching of evolution as applied to man, and

"*Since* it has been asserted that there is not a fact in the universe in support of this theory, that it is a 'mere guess' which leading scientists are now abandoning, and that even the American Association for the Advancement of Science at its last meeting in Toronto, Canada, approved this revolt against evolution, and

"*Inasmuch* as such statements have been given wide publicity through the press and are misleading public opinion on this subject,

"*Therefore,* the council of the American Association for the Advancement of Science has thought it advisable to take formal action upon this matter, in order that there may be no ground for misunderstanding of the attitude of the association, which is one of the largest scientific bodies in the world, with a membership of more than 11,000 persons, including the American authorities in all branches of science. The following statements represent the position of the council with regard to the theory of evolution:

"1. The council of the association affirms that, so far as the scientific evidences of the evolution of plants and animals and man are concerned, there is no ground whatever for the assertion that these evidences constitute a 'mere guess.' No scientific generalization is more strongly supported by thoroughly tested evidences than is that of organic evolution.

"2. The council of the association affirms that the evi-

dences in favor of the evolution of man are sufficient to convince every scientist of note in the world, and that these evidences are increasing in number and importance every year.

"3. The council of the association also affirms that the theory of evolution is one of the most potent of the great influences for good that have thus far entered into human experience; it has promoted the progress of knowledge, it has fostered unprejudiced inquiry, and it has served as an invaluable aid in humanity's search for truth in many fields.

"4. The council of the association is convinced that any legislation attempting to limit the teaching of any scientific doctrine so well established and so widely accepted by specialists as is the doctrine of evolution would be a profound mistake, which could not fail to injure and retard the advancement of knowledge and of human welfare by denying the freedom of teaching and inquiry which is essential to all progress."

The reason why the public was so much interested in Bateson's attitude was because there was at the time a renewal of the attack on the part of some of the religious world on the idea of evolution.

As explained above, this battle had waged bitterly and long, but for a generation, almost the entire scientific world had come to accept evolution as naturally as they accepted the idea that the earth was round and that it revolved about the sun. They had nearly ceased discussing it. They had gone on to the problems that resulted from its understanding. They were wondering how children come to resemble their parents, and why they do not fully resemble them. They were debating whether the

effects of use of an organ by a parent would appear in that organ in the offspring. Meanwhile, and most regrettably, they were forgetting that the great mass of people never came to a university, and that a new generation was growing up who knew nothing of the old struggle and its final solution. Above all, with the growing technicality of their work, they were speaking a language which the public at large did not understand. So it came about, when Mr. Bryan made his attack on the idea of evolution, he found fallow ground. He is one of the most accomplished speakers in America. His long connection with the intimate organization of one of the two great political parties had given him both standing and experience in stating simply and persuasively, in language the least trained could understand, the attitude he took on any question.

Of late years he had added to his political experience, another no less valuable. The Mother Chautauqua, on Chautauqua Lake, had taught the people how profitable it is to spend a part of the summer catching up with new ideas and new movements, by listening to leaders, who can tell their story simply.

In many parts of the country there sprang up other Chautauquas, for they all adopted the name of the lake by which the Mother institution was located, as the class name of that kind of institution.

To very many of these Chautauquas Mr. Bryan came. At many of them he was quite the most accomplished speaker their patrons had every heard. His language was simplicity itself, and never coarse or vulgar. He was always dignified and earnest, and transparently sincere. Then came the tent Chautauqua, staying only a week in

a place, and there were so many of these, that perhaps a thousand towns and villages held one or other of them for a week each summer.

No man was more welcome to any of these than Mr. Bryan—and quite naturally so.

Hence, when this man, with his enormous following, began to attack evolution, it was no negligible matter. His objection was one of which he had little difficulty persuading very many of them. He attacked it because it seemed to him, and he had little difficulty in making it seem to them, that here was direct contradiction of a perfectly clear statement of Almighty God. Who, accepting that as a fact, could doubt whether God or the scientist is right? Certainly very few American biologists would question the conclusion, if they were persuaded of the truth of the premise. The great body of American scientists believe themselves to be religious men. The great majority of them hold connection, at least as active as that of most business men, with some religious organization, church or synagogue.

Of course to them Mr. Bryan's conclusion is wrong; and his premises are just as wrong. The anthropologist—the student of man—believes man has evolved like the rest of the animals, not because there is yet any very large body of direct proof, but because all the proof that applies to the animal world in general seems to the scientist to apply in exactly the same fashion to man. The amount of actual material at hand bearing on the direct problem is as yet scanty, but is by no means negligible. It is very rapidly growing. The evidence comes steadily in. Every now and then a new skull turns up. At present it is newspaper fashion to attribute at once fantastic age to every

such a find. The newspapers give wide publicity to every new case. All this is well. It will help to make it sure that when there is a find of real value, it will not be carelessly dug up by a man who breaks or loses half the bones and makes it difficult for the geologist to tell just where it was the rest came from, and hence how old it may be.

There has been another good result from the activity of the anti-evolutionists. The literature of the subject finds abundant readers and our best anthropologists are giving us book after book bearing on the problem, any good book being sure of a market. Of course unless enough people will pay for a book to defray the cost of its publication, we must have few books. Many of these new publications are admirable, but most of them are too detailed and perhaps a little too technical for the average reader. The kindness with which my preceding book "The Meaning of Evolution" was received, leads me to hope that this book may prove similarly useful. I have made all my statements in this book in the constant hope that they may be clear to the average reader and that he may easily discern from the character of the statement whether it concerns a known fact, a generally accepted conclusion, a debated position or a mere surmise.

After all, there is a deeper purpose in my own heart. I am in the position of many other teachers of biology. I have taught sciences for forty years, and for thirty of them almost exclusively biological sciences. I have taught evolution all that time, have taught it either in the classroom or from the lecture platform. I have taught it to many thousands of people. In all that time I believed myself most solicitous for the spiritual, yes, the religious,

welfare of my pupils. To be told now, that all of this has been destructive of character and subversive of religion hurts, even though I believe those who say so are mistaken. They are usually people of more than common earnestness and seriousness, as good people as any in the community. Naturally the teacher wishes to have the confidence of the parents of those whom he teaches. I think for the most part I have had that confidence. Perhaps I am mistaken. My teaching days are drawing to a close. Already I have given up the regular classroom; it is only a matter of a few years before I shall give up the platform.

But the country is full of young teachers of science. If they are to do their work with hope and joy, they must have the confidence of the public. It is with the earnest desire that I may contribute my share to securing a better understanding of the attitude of science in the public mind that I am undertaking this book.

The American Institute of Sacred Literature, of Chicago, has printed a leaflet signed by a most striking group of people prominent in the religious and scientific world. They say, amongst much more: "We deeply regret that in recent controversies there has been a tendency to present science and religion as unreconcilable and antagonistic domains of thought. It is a sublime conception of God which is furnished by science, and one wholly consonant with the highest ideals of religion, when it represents Him as revealing Himself through countless ages in the development of the earth as an abode for man, and in the age-long inbreathing of life into its constituent matter, culminating in man with his spiritual nature and all his God-like powers."

Amongst the signers connected with the religious world are Bishops Lawrence of Massachusetts, Manning of New York, Johnson of California, and McConnell of Pittsburgh, Presidents McClure of McCormick, and Barbour of Rochester Theological Seminaries, Presidents Burton of Chicago University, Poteat of Wake Forest College and King of Oberlin, besides a number of other well known clergymen.

Amongst the scientists who sign the paper are, President Walcott of the Smithsonian Institution, President Merriam of the Carnegie Institution, President Angell of Yale; Physicians Mayo of Rochester, and Welch of Johns Hopkins; of Physicists, Professors Pupin of Columbia and Millikan of Pasadena, Campbell, the astronomer of the Lick Observatory, Conklin, the Zoölogist of Princeton, Osborn of the American Museum, and a number of others.

Surely one may not lightly dismiss as untenable the side of a controverted subject which is sustained by men so eminent in their several fields as these, certainly amongst the most eminent in America.

MAN'S LIFE ON EARTH

CHAPTER I

A Flight of the Imagination

Our short memory. The length of time. Changes in the face of the earth. The geological periods. When the lizards ruled. The coming of the mammals, and of their group with grasping hands.

I

Whenever, in America, we come to a house that is one hundred years old, it seems to us to run back a very

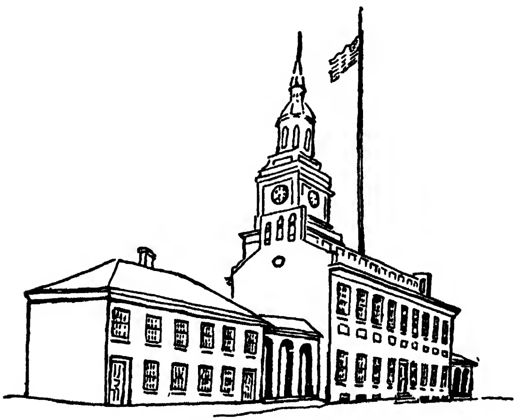


Fig. 1. Independence Hall, 150 Years Old.

long time. To go into Independence Hall and see a room restored as it was one hundred and fifty years ago seems

to stretch us not a little. We go to Jamestown and see standing before us a dilapidated, fire-smoked building in ruins, that runs back two hundred years and we feel quite

FIG. 2. OLD HOUSE IN ST. AUGUSTINE, 300 YEARS OLD.

FIG. 3. THE COLOSSEUM, 2000 YEARS OLD.

impressed. Then on to St. Augustine we travel, and we realize we are in a city three hundred years old. We remember, with a little relief, there has been an interval

of oblivion in its story. We realize we are now nearing the beginning of American history. But our history roots

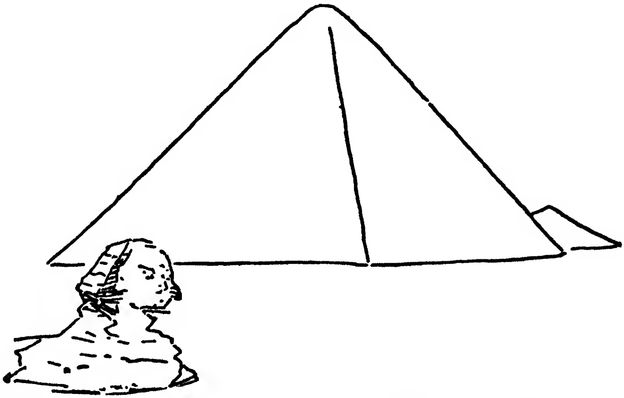


FIG. 4. THE PYRAMIDS AND THE SPHINX, 3000 YEARS OLD.

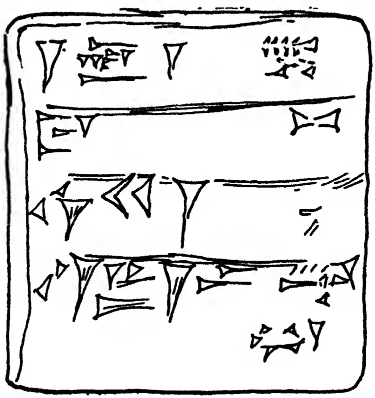


FIG. 5. BABYLONIAN BRICK, 4000 YEARS OLD.

back into that of Europe. There we may easily go farther back. Why not take a jump back to the Colosseum at once, a jump of nearly two thousand years? Or to the tomb of

a Pharaoh, with its three thousand years? A clay brick, with its wedge-shaped indentations, brought from the valley of the Euphrates, carries us back four thousand years. Now we have come to the point where not many years ago we would have felt we must stop. Does not six thousand mark the time since the "beginning?"

This far back history runs. What of man before he could write history? Is there a story of man far back of history? Far back of man who could transmit even

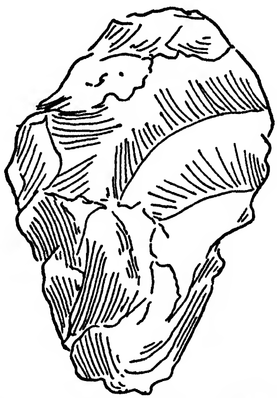


FIG. 6. CHELLEAN HAND AXE, 50,000 YEARS OLD.

legends? Far back of man who could make anything that proclaims him man? Was there a period when he was too lowly to really deserve the name of man and yet too advanced for us not to recognize his kinship? These are the real "dark ages," and very dark and very long they are. If we are to understand the length of them we must stretch our power of the imagination. To this end, let us turn to those who study not the history of the earth but the story of the universe.

II

Astronomers have lately been telling us of measurements they have been making of the distances to the stars. These distances can be expressed in miles, but the strings of figures carry no significance whatever to our minds, with their limited experiences. The imagination stands aghast. The ninety-three millions of miles from the earth to the sun are enough to stagger us when we try to visualize them. Should a train start to-day for the sun and travel uninterruptedly, day and night, it would take a longer time to reach its destination than has elapsed since the year Jesus of Nazareth was born. So we need a larger unit than that of the mile and a quicker speed than that of the train, if we are to bring these distances within our comprehension.

The audiences that may listen to our great speakers have been recently much enlarged. A great convention may be held in New York, and lovers of radio may hear the addresses all across the continent. The electro-magnetic waves that carry those addresses through space travel so much more rapidly than sound waves do that people in San Francisco, who have the earpieces of the receiver on their ears, actually hear the words of the speaker before those of the audience who sit in the rear of the convention hall can get them. The speed of radio transmission is the speed of light. The rays of light either are electro-magnetic or they travel with the same speed as the waves of electro-magnetism. This is at a rate of one hundred and eighty-six thousand miles a second. Let us fly to the sun on the beam of light instead of traveling by train and we will reach our destination in eight

minutes. Of course, if we turned back and looked at the earth, and could see things happening there, we would be getting our news just eight minutes late. In other words, the things which we see happening have really happened eight minutes earlier.

Emboldened by our experience, let us leap to our sister planet, Jupiter, and turn back and look at the earth. Then

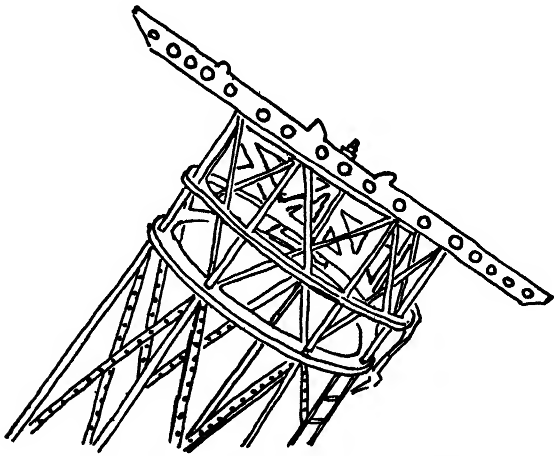


FIG. 7. THE YARDSTICK OF THE STARS.

our news would be coming in about three-quarters of an hour late. Another hop might take us to our most distant sister planet, Neptune. Turning back and looking at our far-away home, could our eye discern what was going on there, the news would be about four hours late. In other words, what seemed then to be happening would really have occurred four hours earlier, and the news be just reaching us.

We have now grown daring. We have traversed the

group of known bodies revolving about our sun, and forming the Solar System. Let us start out for the next nearest sun—or star. For the stars are suns, or our sun is a star, just as we wish to put it. What makes our sun seem so much larger and brighter than the stars is simply its nearness to us. It is not even a big star. If we have

FIG. 8. ORION AND BETELGEUSE.

headed for the nearest star, when we arrive at our destination let us again look back to the earth, to see what is happening there. What will meet our gaze? The things that transpired not hours nor weeks nor months before. The nearest star thus far discovered is four light years away. Looking back from the bright yellow Dog Star, Sirius, our news would be nearly nine years behind time. A few

years ago we were startled by the news that Professor Michelson had balanced a marvelous measuring stick across the end of the Mount Wilson telescope, and measured the diameter of the brilliant star in Orion, Betelgeuse. Turning back here for news, the returns would be belated by one hundred and sixty years. We might see our colonial ancestors—were we looking at this minute—running to and fro in the uneasiness that is later to result in the separation from the mother country, though the unrest had not yet reached its Declaration.

Not far distant from Betelgeuse, as it looks from here to our eyes, we see the beautiful group of the Pleiades. If we could leap to these and turn back our telescope on the earth, with vision strong enough to see what is going on, we should be gazing on the American Continent untrodden by the foot of the white settler, for what we would see to-day at the Pleiades occurred on the earth in 1600 A. D. Let us make one more leap, grander than any we have thus far taken, and leap onto the remotest star of which the astronomers have thus far estimated the distance. This will be the dimmest star, visible on the most sensitive photographic plate in the strongest telescope: a star in the Milky Way, on the borderland of our Universe. If now we could look back once more, we should see, so the astronomer tells us, what was going on in the world three hundred thousand years ago. Let our imagination picture for us this distant portion of our own past history. As the earth turned under our gaze and we searched its surface with eyes made keen by a telescope far greater than any man has yet constructed, should we see men? Would there be men there to be seen? Would there be anything that looked like men? Would we recog-

nize the creatures there that are to be men in later generations?

III

Having taken our first flight of the imagination with the astronomer, to give us some dim conception of the immensity of known space and incidentally of time, let us surrender ourselves to the spell of the geologist and listen to his no less remarkable story. We are looking down on the earth as it spins under our eyes. Even though we are familiar with our globe as it exists to-day, it is almost impossible to recognize the lay of the land on the earth as it was half a million of years ago. Bridges of land join many of the continental masses which are now severed by open water. Regions that are now great plains were perhaps then the bottoms of magnificent gulfs and estuaries. Even at that time, the most striking upraised mass is that of the great plateau, crossed from east to west by a series of waves of mountain chain, parallel with and north of the Himalyas. The geologist tells us that, in the Tertiary Age—the Age of Mammals—all the country to the north of these mountain ranges was a magnificent continent which he names Angara Land. For a long time a gently sloping plain swept down to its southern shores. This met the water's edge just above the present position of the mountains. This sea he names The Tethys. It separated Angara land to the north from Gondwana Land, including the present peninsulas of India and much area now under the Indian Ocean, and embracing also Madagascar and much of central Africa. Then the geologist tells of us of one of the great eras of

contraction, when the earth's surface buckles in new places as the cooled exterior adjusts itself, through long ages, to the cooling and shrinking interior of the earth. Slowly the sediments carried down in the waters of the rivers that flowed southward through Angara Land have

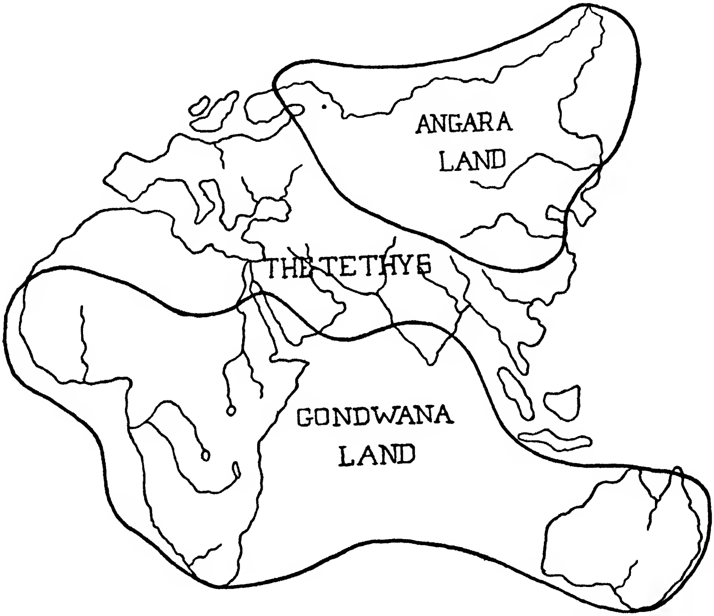


FIG. 9. MAP OF THE EASTERN HEMISPHERE IN THE EARLY TERTIARY TIMES.

been distributed over the bottom of The Tethys. Slowly the heat has spread up through the layers and softened them. Then, with a slowness tolerable only by the Eternal God, to whom time is meaningless because He is unending, a new thrust folded up a new plateau. Before this new uplift Angara Land had lain open to the winds

of the warm sea. Over its wide expanse waved magnificent forests, fed by the warm, moist winds of a tropical sea. Gradually the southern border of this shady Angara plain was uplifted and formed into a plateau. Later this became wrinkled into ridges and washed here and there into the gorges and valleys of a great mountain system. These changes in the face of the land brought a steady alteration of the climate of the region. But every change in the climate must be accompanied by its sequent modification of the vegetation. The lifting of these hills produced a double effect. The elevation itself brought greater cold. In addition, the uplifted mass, cutting across the path of the great winds, made them pour their wealth of water down the southern slopes. As the mountain grew higher the country beyond grew steadily colder and drier. A forest can live only where there is a fairly heavy rainfall, well distributed through the year. A luxurious forest of tropical trees with their gorgeous flowers and luscious fruits is dependent on an abundant rainfall and great warmth. As both moisture and temperature slowly diminished on the plateau, there came an equally steady change in the plant growth of the area. Gradually the dense tropical forests were replaced by more open temperate forests with an increased amount of grass between the trees. After a time even these temperate trees began to fail. The forests became more and more open, and grass began to cover greater areas of its floor. As the ages passed, open glades of grass appeared here and there amongst the forests. Gradually these glades extended until they met, leaving only islands of forest in the open plain. For a long time these scattered patches of forest were quite extensive. Ruthlessly

the drying went on with the rise of the mountains and soon the trees lay only along the water courses and on the slopes of the hills themselves. The great plain was covered with grass, but even this began to brown early in the summer. Later the prairie became a steppe which is itself to give way gradually to a desert. The geologist tells us all this history can now be read in the hieroglyphics God has inscribed in the rocks—a form of revelation we are only beginning to interpret with clearness.

IV

Having dreamed our dreams with the Astronomer and with the geologist, let us submit ourselves to the teachings of the Paleontologist and listen to his story of the animals that lived in this land while all these changes were going on.

Every form of vegetation has a corresponding type of animal life. The creatures that live in the forests are not those that live in the glades. These again are different from the animals of the prairies, while still others roam the steppes. Last of all, a few forms fight a dreary battle on the edges even of the desert. The mammals—hair-covered, milk-giving animals—are a recent development in the earth's history. They certainly have not existed for much more than the last one-tenth of the history of the earth, however long that may have been.

It is an exceedingly difficult matter to decide how long the earth has existed. Many men have approached the problem from many directions. One studies the rate at which the heat of the earth is now escaping into space and tries to determine how long the process must have

been going on for the temperature to have come down to its present stage. Another studies the amount of salt the rivers of the globe are now turning into the ocean, and the amount of salt already there. This will give some indication of how old the ocean must be to have grown as salty as it now is. Still another studies the rate at which the forces of erosion—rain, frost, flood—eat away the continent and how much of the rock mass has been thus eaten in the past. This again gives us some idea of how long the erosion has been going on. Still another will try to measure the amount of sediment now being carried by the rivers into the bays and estuaries and the parts of the ocean adjacent to the land. Then the known, or calculated amount of stratified rocks, which have been thus produced in the past, will give another means of calculating how long the process has continued. No one of these methods is exact. Combined, they do not give us even approximately the same results. But the answer to them all comes out in such size as to make it sure that thousands are all too small to serve as a unit. Even millions are none too large, and the earth must be many millions of years old. Perhaps it will come as near as may be to an approximation of the result of them all to provisionally assign one hundred millions as the number of years since the earth's birth.

If there is any temptation on the part of present-day investigators to alter this figure, it is not to reduce it, but instead, to greatly enlarge it. The students of radio-activity think they can tell the age of certain rocks containing radium. They tell us uranium breaks down through radium into lead. We used to call the lead in a uranium mineral an impurity. Now we know it is an

alteration product. The radium students believe they can tell by the proportion of lead to uranium in any particular mineral specimen how long the process has been going on. Other students of radio-activity tell us that they can judge the age of a piece of mica by the character of certain spots with haloes about them, caused by the escape of the radiant energy. These investigators ask us to assign to their specimens and to the strata in which they are found, not thousands or even millions of years. They tell us to count in billions. As yet, the great body of scientists is too conservative to accept the new figures, and we will join many others in tentatively taking one hundred millions, knowing that it may be altered either way when scientists discover more certain foundations on which to base their conclusions.

It is not quite so hard to tell the relative lengths of the various geological periods. The thickness and character of the strata formed in each is a reasonable guide, though Geologists will certainly, as time goes on, come to a nearer agreement.

To give us some sort of an idea of the time involved in this past history of the earth, let us consider the entire period of its existence as if it were one day of twenty-four hours. We must realize that the changes of the first twelve hours are so old and have been so serious as to render illegible any evidence of the sort of life that existed then. By the time we get above the early rocks, with their evidences of intense heat and alteration, clearly half the time has elapsed. We now come to the rocks which still retain the layered structure they had when they were formed by the settling of the silt in the water,

and its subsequent hardening under mild heat and pressure. These layers—strata—are sometimes abundantly filled with fossils and often show very clear evi-

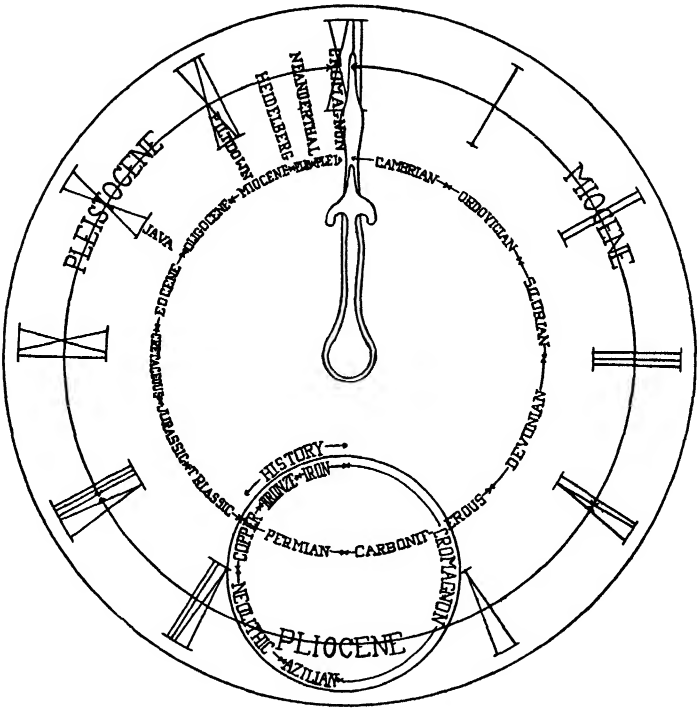


FIG. 10. THE CLOCK OF TIME.
All the time since stratified rocks are present is represented by twelve hours. Time since mid-tertiary is one hour. Time since Neanderthal man is one minute. History embraces eight seconds.

dences of the character of the animals and plants then living. Sometimes we can tell the nature as well as the location of the land and sea areas, and, we lately think, of the climate.

Counting one day as running from noon to noon, we will pay no attention to the first half, running from noon to mid-night. We will only try to cover the space from mid-night to the present second, noon of to-day. It will be well also for us to remember that the student who believes that man is the ascended representative of forms originally lower, sees no more reason to look for a break in the chain at any earlier point than he does for expecting one at the beginning of his life as man. To him, every living creature on the earth is blood kin to every other living creature. The less alike any two animals are the farther back into the past must we go to find a common ancestor. If we go back far enough we will find a type of ancestor common to them all.

Turning now to our time clock, we find that from mid-night up to about three o'clock there were present perhaps only for the last half hour the earliest traces of any creature with a backbone. From about three o'clock to half past four the backbone was developing finely through the Age of Fishes (Devonian). All the vertebrates—as we call the backboned animals—during this entire period were fishes. Not one of them seems to have come out on land. From four-thirty until six the ground was covered in all low-lying places with a rank growth of trees and ferns which have since become the beds of coal. During this period (Carboniferous) out of one group of the old fishes there developed a line whose swim-bladder became a lung and whose fins were jointed and split into toes. This group of the amphibians was much like the newts and salamanders and frogs of to-day, with a water-breathing early life, the tadpole stage, and an air-breathing

period of adult life. These creatures contained the possibilities of all the higher groups later to live on the face of the earth. From six to seven is a transition period (Permian), when again a prophetic section of the amphibians began to hustle through their tadpole stage before leaving the egg, and the reptiles were here. They held sway from about seven to a quarter after nine (Mesozoic). At this point some of the reptiles, as will be described later in the chapter, became warm-blooded, hair-covered, milk-giving animals—mammals—including some that are later to give off all the monkeys, apes and men. The earliest fossil showing any near kin to man—the Java skull—turns up about twenty minutes of twelve. The Heidelberg jaw—undoubtedly human—is placed at about ten minutes of twelve. At five minutes before noon Piltdown man has come and is followed for several minutes by the first real man of whom we know much, Neanderthal man. The last minute only—about twenty-five thousand years—has seen man as we know him to-day.

Let us turn now to the second hand to split our last minute. About the first twenty-five seconds is occupied by men of the Cro-Magnon type—the first really fine men—who had chipped flints for weapons, though they used bone also, but they still hunted all their food. During the next ten seconds there was a mingling of the older form with some newer types of men, who brought in polished stone weapons. These brought with them into Europe from their Asiatic homes the art of breeding animals and planting crops. For the last fifteen seconds man has been using metals, first copper, then bronze, and for the last five, iron. All the recorded history of man, inscribed on

his monuments or written on parchment and later on paper, falls within about the last eight seconds.

V

Amongst the skeletons in the great museums, few attract so much attention as those of the giant lizards (Dinosaurs) of the age of Reptiles (Mesozoic). The largest of these creatures measured as much as seventy feet in length, and must have weighed no less than twenty tons. The skeletons of these creatures have been unearthed in such quantities as to make it evident that they were very abundant in their time, and of very varied forms. Some of these lizards roamed the land, leaping on their prey. Others supported their heavy bodies by submerging them in pools and feeding on the lush vegetation of the water's edge. Some were adapted to swimming like great fish in the waters of the sea and of the great gulfs. Some flew through the air like mighty bats. They were all reptiles, and, like the reptiles of to-day, were what we call cold-blooded. This phrase describes them but indifferently. On cold days they are cold; on warm days, warm. Their temperature is never much above that of their surroundings. Their lungs are not complex enough nor the circulation of their blood advanced enough to permit them to manufacture their own heat rapidly enough to keep them warm. But this mattered little in those days, for the climate was then much warmer, where they lived, than it is to-day.

Between the feet of these gigantic creatures crept a few small reptiles, with a slight improvement in their construc-

tion. Their teeth did not form a simple row of similar points; they were beginning to differentiate, to grow unlike each other. Some of these teeth were flatter front and back than others; others were lengthening, still others were getting stout, and uneven on the top. But the most important difference between these animals and their nearest allies lay in the fact that their hearts were becoming completely four-chambered while their companions had but three. This enabled them to keep completely separate the blood which was on its way over the body from that on its way to the lungs. This permitted a richer absorption of oxygen, hence a more thorough and rapid combustion and a higher temperature. Gradually, also, these forms developed a nervous circuit for regulating this process and the first truly warm-blooded animals in the world appeared. Other animals had sometimes gotten as warm when the weather was warm, but these new creatures kept their warmth steadily. It is more appropriate to call them even temperatured, than warm-blooded animals.

This constancy of temperature and increased warmth were perhaps, at first, of little advantage to them so long as the climate itself remained warm, as it did throughout much of the Age of Reptiles. But this Age closed with a great drop in the temperature of the atmosphere, due perhaps to the more striking uplift of the lands and in part to the greater clearness of the air. Whatever may have been the causes, it is evident from the fossils, both of animals and of plants, that a decided lowering of the temperature then occurred. Such conditions are very hard on reptiles. Their annual period of activity became shorter and their period of stupor—their hibernation—

became greater each year until most of them gave up the game and retired forever; became, as the Geologist says, extinct.

Could the giant lizards have had a sense of humor, they would doubtless have laughed to scorn the prophetic member of their group who should foretell that the little creatures creeping about their feet, creatures hardly bigger than a squirrel, were to outlive them and to become the masters of a later age. But such was the case. When the cold was over, and a newly genial atmosphere once more played over the land, the great reptiles had disappeared and the Age of Mammals—the Cenozoic—had begun.

The reptiles who were ancestral to the mammals had at first small sensitive hairs sticking out between their scales, chiefly to give them knowledge of their contact with things about them. Gradually, as the temperature of the body increased, these hairs multiplied and the scales disappeared, though the armadilloes still have them. Nor did all the scales vanish, even from the most advanced of these creatures. At the end of each toe, of both the front and the hind feet, one scale remained. This scale is eventually to become in some, a claw; in others, a hoof; in still others and much later, a nail.

These new mammals, the ancestors of all the later warm-blooded, hair-covered, milk-giving animals, were doubtless at first very much alike. When our colonial forefathers came to this country there must have been a great similarity between the occupations of most of them. Each cut down the trees, each built himself a log cabin, each cleared the ground, each planted his crops and gathered them in. Only later did it become possible

for one to become a lumberman, another a farmer, another a herdsman, still another a trapper; even, in time, one of them became a teacher.

As in the Mesozoic Age the reptiles had radiated, developing into forms to fit each kind of situation, so the new mammals came to differentiate and to take advantage of varied conditions in the environment. One section of them grew strong, long, chiseled front-teeth to nibble at first bark, and, later, nuts. Those who varied in this direction were the ancestors of the beavers and muskrats, the porcupines, woodchucks and rabbits, the rats and mice, the chipmunks and the squirrels of a later day. These learned to avoid their enemies by hiding in the water, in burrows or in hollow trees.

Another group grew lengthened claws and longer and more pointed eye-teeth. These well-weaponed creatures became the bandits of their time, killing and devouring their less protected cousins. They were the ancestors of the wolves and jackals, the tigers and lions, the cats and dogs of to-day.

Still another set had their claws flatten and spread around their toes and harden into shoes so that they were enabled to walk on the tips of their toes. These were the ancestors of the deer, the sheep, the cows and, finally, of the one-toed horses of to-day.

What at first might seem the least promising of these groups was a set that gathered insects for their food. Their feet had not specialized for digging or catching prey or running rapidly on the tips of their toes over hard ground. Their teeth had not specialized either for tearing flesh or for grinding grasses and grains. But their heads were large for the size of their bodies as compared

with their cousins of other groups. They perhaps had a habit, somewhat like that of our squirrels of to-day, of sitting up on their hind feet, even standing up on them to look out for their enemies. Thus they might see their approach while they were still far distant. This habit of rising on the hind feet made their larger brains of so much greater use to them. At the same time, it often freed their front limbs from use in locomotion, and they came to use them for grasping things. Slowly the inside toe on each front foot acquired a greater swing and at last this toe became so turned that it could grasp in opposition to the other four. To meet the combined strength of the other four fingers, the thumb had to grow heavy and lose its skill. But the four others more than counterbalanced the clumsiness of the thumb, by an increased dexterity. This was especially true of the finger that came nearest the thumb in grasping, and thus gained the largest experience. When their enemies pursued them their method of escape was naturally suggested by their frequent upright position and their grasping hands. These creatures took refuge, from their attackers, by climbing into the trees.

From this group have descended the lemurs, who, of all living forms, must most resemble the old ancestor of the entire group. The monkeys were a later development of the main stem, and still later the apes branched off. Just where the main stem became human; how long the other branches were separate and parallel; cannot yet be well told. Certainly no type of monkey or ape of to-day resembles the common ancestor much more than we do. The monkeys and apes are doubtless far more specialized for tree dwelling than the ancestors of man ever were. Yet it is doubtless true that, if we could see

this common ancestor, and if the ascent of man from lower forms is at all repugnant to us, we would not be much more pleased with him. To many men who have attained high position amongst their fellows it is a source of pride that their ancestry was humble. Why should not this be quite as true of their attitude towards the much earlier progenitor of the human race? If so much, under the working of Almighty God, has already come from so humble a beginning, then surely much more may still be effected. This is the source of our finest hope for the future on earth of the human race.

CHAPTER II

A Gleam of Evidence

The importance of fossils. The Asiatic hunt for fossil man and the Java find. The supposed Java half-man. The descent from the trees. Combining to hunt animals. Attempts to restore the half-man.

I

How delighted the student of fossils would be could he come across a complete skeleton of an undoubted ancestor of the human race, too advanced to possibly belong to any other line and yet clearly only in part human. If man has really ascended from lower forms, it is more than probable that somewhere there is at least one such skeleton. Of course multitudes of men and animals have lived in the past, whose bodies within a few years, at least a few centuries, after their death, have entirely disintegrated, leaving no traceable evidence of their existence.

The conditions under which a body becomes a fossil are rarely fulfilled. There have been hosts of species in the past, which now are known only through a single specimen. One of the most important and interesting fossils ever found is that of the archæopteryx. This is a skeleton, reptilian in almost every feature, but having the clear imprint of feathers all about it. It is uniformly

accepted amongst students of such matters as a transition form between the reptiles and the birds. The fossil remains of this strange creature were found in 1861, in Solenhofen, in Bavaria, in a very fine-grained lithographic sandstone, which preserves the imprint beautifully. This specimen is now in the British Museum. It was not before 1877 that the second example, now in the Berlin Collection, was discovered in the same locality. Since that time no similar fossil has been uncovered, there or elsewhere. Hence the fact that no evidence of a particular fossil has been found in a neighborhood is not accepted as proof of its absence from that region. Many species of animals are known each from a single bone. If that bone is characteristic enough—say a lower jaw bone—not a little can be deduced as to the relationship of its owner to other known animals. The teeth of different animals vary greatly, yet each is characteristic of its species. Teeth are preserved better than any other part of the animal and they have been very carefully studied. No entire skeleton of man is known, older than Neanderthal man, who is believed to have lived during a period ranging from twenty-five to fifty thousand years ago. Earlier than this—and we should look for transition forms at a period of perhaps five hundred thousand years ago—we have no even possibly human remains excepting a thigh bone and some fragmentary skull bones. Of course we have chipped flints that are more and more crude as we go lower in the strata and hence farther back in time. Finally it becomes impossible to tell which flints are the result of artificial flaking and which have been made by the tumbling together of fragments of flint in landslides and floods.

In spite of all this, so strong is the conviction on the part of scientists, of the great age of man, and so definite are the indications that the home of early man is to be found in Central Asia, that one of the best equipped expeditions that has ever been sent out to find fossil specimens was sent into that region. The American Museum of Natural History and the magazine "Asia" have already sent their scientists out on one trip, under the leadership of Mr. Ray Chapman Andrews, to study that locality. After being gone for many months they returned with abundant materials of many kinds, including the eggs, possibly the embryo, and certainly a number of stages in the life of one of the great lizards of the Age of Reptiles—a dinosaur. Of human ancestors not a bone was found. The materials discovered well repaid the trouble, but they came home without the fossils they most desired. This failure did not daunt them. They are now preparing for a second expedition into the same region. This again may come home without the quarry they so earnestly seek. If we know anything about the conditions under which the late stages in the evolution of man occurred—conditions of plain and steppe, and perhaps finally desert—they are the most difficult conditions for the formation and preservation of fossils. These are commonly produced when the dead body of an animal is washed into an estuary or lake and soon covered completely by mud, under conditions so antiseptic as rarely to occur. Even though no fossil of a half-man should ever be found, the student of human prehistory will still believe in his existence from abundant indications, some of which will be later discussed. These he interprets as clearly pointing to such an ancestry. So the second An-

drews expedition will go out in eager hope of finding the skeleton of a human precursor, but prepared to be not too greatly disappointed should no such good fortune crown their efforts.

II

Even though the skeleton of a clearly prehuman ancestor should never be found we are not without a gleam of evidence as to his character. We have a few bones of a creature which, while probably not in the direct line of man, lies at least quite as near to that line as it does to the apes.

In 1891 a Dutch army surgeon was stationed in Java. On the southern slope of this island is the Bengawan River, which flows past the village of Trinil. Dr. Eugene Dubois is a student of fossils and was interested in the remains of prehistoric animals which were buried in the banks of the Bengawan. During the dry season a shelf of the bank was uncovered. Digging on this shelf, the explorer found a tooth, evidently an upper molar, not entirely human and yet not ape-like. It was some weeks later that he found, at the same level but more than a yard away, a skull-cap which has perhaps been more discussed than any other one fossil bone yet discovered. Dubois was much elated, but wished to find more of the skeleton before reporting his good fortune. The oncoming of the rainy season interrupted his work. The next year, when the river was once more at its lower level, work was resumed. This effort was rewarded by the uncovering of a thigh bone at a point about fifty feet nearer the river than that at which the skull-cap had been

found, but at the same level. Still later another molar tooth was turned up. The four specimens had been found nearly in a line and all within the same level of the strata. The bones were completely fossilized, dark brown and quite hard. Bones of animals found at the same time and at the same level were similarly colored and fossilized. These were the bones of animals for the most part either extinct or at present not found in Java. There is considerable difference of opinion as to whether these bones, including the skull, thigh bone and teeth, are from the Pliocene or the Pleistocene, that is, whether they come from the late part of the Age of Mammals—the Tertiary—or from the early part of the Age of Man—the Quaternary. That they are very old admits of no doubt. If we take the figure accepted by Dr. Osborn in his "Men of the Old Stone Age" half a million years seems none too great.

In 1907 and 1908 Madame Salenka made an expedition to Trinil which searched carefully for further remains of this creature. They found nothing more which could have belonged to it excepting one molar tooth. To the layman it may seem absurd to build up the body of a man out of a few bones, especially when we consider that part of these are fragmentary. The scientist would of course be glad to have more to go on, but he must make the most of what he has. If he must content himself with a few bones, these are a fortunate collection. The skull-cap tells much of the brain it encased, and this of the intelligence of the creature to which it belonged. In addition, the ridges on the surface of the skull form the line of attachment of muscles, especially of the neck and jaw. The former help to form a good judgment as to the

angle at which the head met the body; the latter speak of the direction and strength of the jaw. The character of the jaw is further evidenced by the two teeth, which also tell a part of the story of the food. As for the thigh bone (femur) the smooth surfaces on the ends, where it comes in contact with the hip-socket above and with the shin bone at the knee, help to declare the angle at which the bone was placed, and hence the degree of erectness or of slouch in which the creature customarily stood. A large bone swelling on the femur is the evidence of serious disease or injury, and gave color to the claim of one anatomist, that the creature had been a syphilitic idiot —human but terribly degenerate.

A glance at these bones will show, even to one who is not an anatomist, the reason for the long debate that has raged over them.

The skull-cap is by far the most interesting of the finds. A striking feature is the very marked projecting ridge over the eyes. This is a character common, and often more marked in some of the apes. It is very noticeable in the Chimpanzee, "Polly," in the New York Zoölogical Garden, and is absent in the orangs. It has also been found, though less marked, in a later form of undoubted man, the Neanderthal man. Returning to our Java skull-cap we see that back of the ridge over the eyes, the forehead is both very sloping and quite narrow, though the head is wider in the back. The finder, Dr. Dubois, has made a drawing of his calculated restoration of the entire skull, and has endeavored to estimate the contents of the brain case. His figures have been modified slightly by later workers, but there seems to be general agreement that the brain contained somewhere be-

tween eight hundred and fifty and nine hundred cubic centimeters (sixty cubic inches). Six hundred cubic centimeters is large for the brain of an ape. The brain of members of the aboriginal races of Australia and Tasmania has been found as low as nine hundred and thirty centimeters, while the average American brain is about fifteen hundred in man and thirteen hundred and fifty

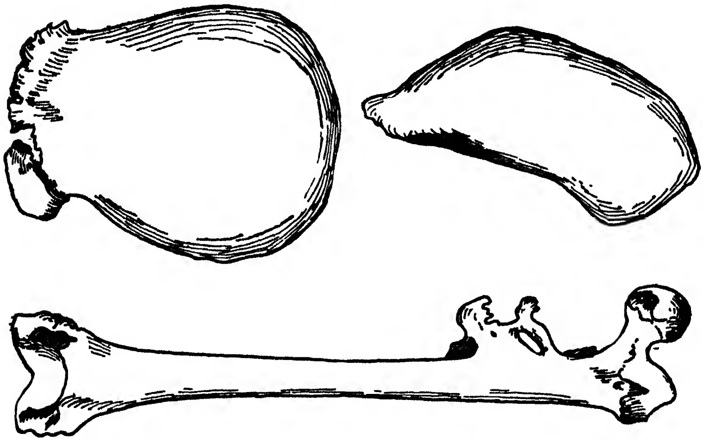


FIG. 11. THE JAVA SKULL-CAP (TOP AND SIDE) AND FEMUR.

cubic centimeters in woman. The creature had far too much brains for any ape, and too little for a normal, modern human being. There are so-called micro-cephalic idiots whose brains are no larger, but in them the form of the head is said to be different from that of the Java skull.

One of the most enthusiastic followers of Darwin in Germany was Ernst Haeckel. He was amongst the earliest zoölogists to make elaborate genealogical tables of the

Animal Kingdom. In these tables he placed, in part, known fossils, in part, animals he conjectured from what seemed to him parallels to present lowly animals. Even so there were gaps which needed to be filled. In these gaps he placed animals as yet unknown, describing their character and giving them group names. In the space

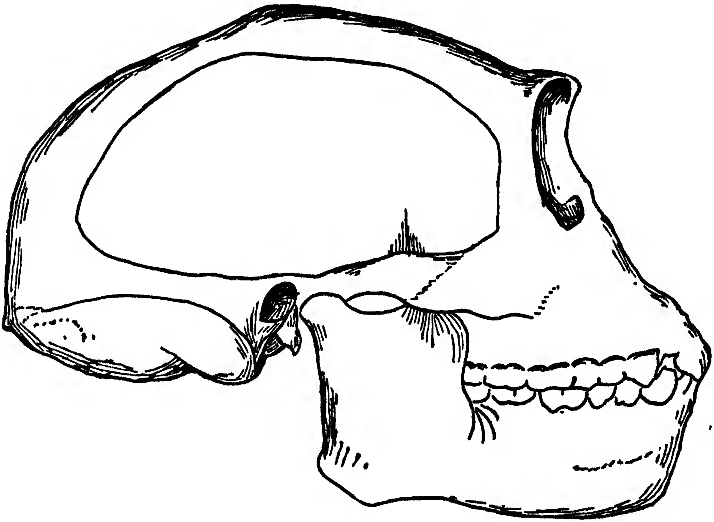


FIG. 12. THE JAVA SKULL AS RESTORED BY DR. DUBOIS.

between Anthropoid Apes and Man he placed a set of suppositious ape-men (Pithecanthropi), while under this general section he placed a smaller group, which he called speechless (Alali), because he believed them not to have developed the capacity for speech.

When Dubois found his skeletal remains in Java, he accepted for the creature to which they had belonged Haeckel's name of Pithecanthropus, but instead of calling

it the speechless ape-man (Alalus) he called it, from its evidently upright position, Pithecanthropus erectus, the ape-man that stands up.

In 1894 Dubois described his find and in 1895 he laid the matter before the International Congress of Zoölogy at Leyden, claiming his find as an example of the "missing link," a transition form between apes and men. Dr. Rudolf Virchow, a truly great scientist, combatted the idea vigorously, and a group of twelve anatomists undertook to examine the question carefully. The result of their investigation was that three of them believed it an ape, confessedly higher in brain capacity than any other known ape. Three of them believed it to be the skull of a lowly or a degenerate man. The other six believed it to be a transition form between the apes and man.

Much careful study has been given to this skull-cap by modern anthropologists. It seems to be the present rather general conclusion that the Trinil skull represents a form very closely allied to an ancestor of man. Little peculiarities lead to the conclusion that it does not lie in the exact line. In other words, it is supposed to represent a very near cousin of early half-man and to give us our best present means of imagining what our earliest clearly recognizable ancestor may have been like.

III

May we now give rein to our imagination and see whether we may romance, if you will, over the possible conditions that carried our ancestors out of the cousinship of the apes into the higher realms that led, in the full-

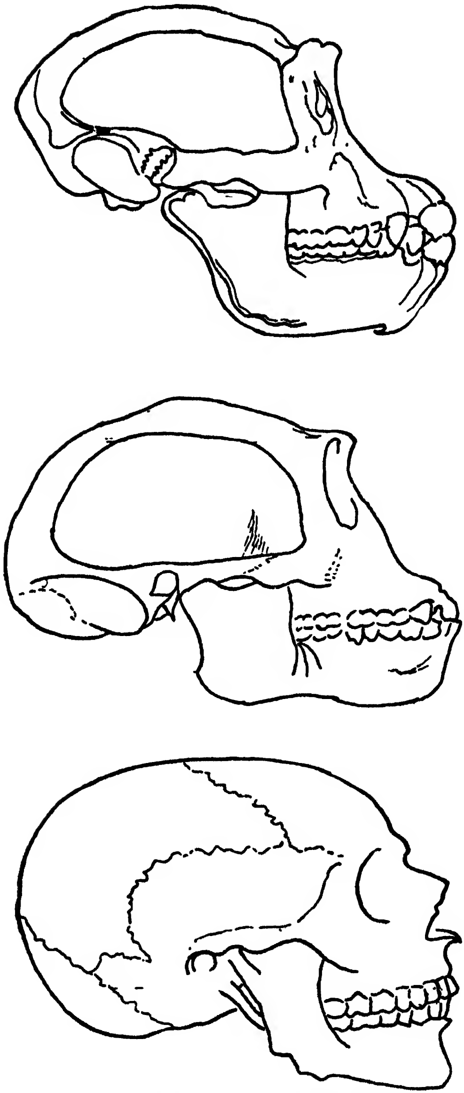


FIG. 13. SKULLS OF CHIMPANZEE, JAVA HALF-MAN AND MAN.

ness of time, in the working out of God's great process, into the full stature of modern manhood?

It is more than probable our ancestor never had become as thoroughly at home in the trees as are either his more distant cousins, the monkeys, or even his nearer parallels, the apes. But we may be thankful he took to the trees, as it gave him his habit of using chiefly his hind feet in supporting his body in climbing, with his head up and his hands grasping the nearest support. Sight began to replace smell as his chief guiding sense, and the brain centers of vision grew with the sense of sight, while the centers of smell dwindled away. This changed the contours of the brain and hence also of the skull. As the swelling brain helps to reshape the skull so that the eyes turn more directly to the front, clear vision with two eyes at once became more operative. This power of seeing things with two eyes at once to-day gives us our main capacity for judging distance, and, with the constant use of the eyes came a new sense of space in three dimensions. The comparative freedom of the hands made it possible to handle many things with the opposable thumb and fingers. The sense of touch, which had been keenest on the muzzle and the tongue—where it is still very discriminating—began to develop more fully on the finger-tips. Manual training formed a large part of the education of our ancestors, as it does with our babies to-day.

In pre-human forms the sounds made by the vocal organs were undoubtedly more like those made by other animals. These sounds expressed emotional states rather than any well formed mental concepts. What brought about the transition to early forms of speech?

When there comes into any region a distinct change in

the conditions, the animals of that region will meet the change by one of three methods. Which of these three will be taken will doubtless depend in part on the nature of the change and in part on the structure of the animal. The simplest adjustment to the alteration of the environment is migration to another region more like the old one to which the animal was accustomed before the change came about. This sort of adjustment is occurring constantly in nature, it being one of the important driving forces in the dispersal of man over the globe. Whenever there is no barrier to such migration, this is the method most likely to be taken. The second method of adjustment is for the animal to become sufficiently modified to adapt itself to the new conditions. This is probably one of the main processes which accompany the evolution of new forms. When the change in conditions is very rapid, when the animal lacks plasticity and when barriers prevent migration the creature must give up the attempt. The animal, unable to find an outlet into a new and suitable region, and too rigid in its constitution to adapt to the new conditions, gives up the struggle. The species passes out entirely and forever—it becomes extinct. It would seem as if, with the gradual passing of the forest, at least two of these adjustments were in active play. The races of the common ancestor who had become best adapted to the trees and hence most firmly attached to them, moved with the trees. These went chiefly to the south, the southeast and the southwest. From them are sprung the apes of to-day.

Another group perhaps had never taken so thoroughly to the trees. They looked to them in time of danger; they traversed their boughs in search of fruits and young

birds, perhaps for insects. But they were always more at home on the ground. Here they maintained their erect position, though, far more than modern man, who still likes to hold to a support while he stands, they aided themselves by catching hold of the natural supports along their pathway.

Perhaps it was the added danger here, and the added need for silence, that taught man the constant habit of communicating with his fellow man by means of gesticulation and of showing the state of his mind by a change of the facial expression. It seems quite certain that gesticulation preceded speech with man, or at least developed first. Certain it is that while there are great groups of languages so alike as to point to a common origin or at least contact of the often widely distant peoples who speak them, there is such variety of groups of tongues and such deep-seated differences in their structure as to point to the dispersal of man before his speech was well developed. Hence stranger races still communicate with some freedom by means of gestures when they have no language in common.

Man was also doubtless more general in his feeding habits than his simian cousins and this made him better able to adapt himself when the trees grew less abundant and perhaps a smaller part of them were fruit bearing.

In addition, there may have been isolation as a considerable factor in his development. The separation of a group of animals from their fellows, by preventing interbreeding and consequent swamping out of the newer forms by the older, fostered the evolution. A group of the ancestral types, with perhaps both tendencies present, the impulse to speech and the willingness to try new foods

found itself in a great island of forest, in the midst of the plain. This locality grew more and more restricted, as the climate became more arid. In this group those who had the more plastic brains, the greater comfort on the ground, the larger willingness to learn to eat new foods and above all, a greater disposition to live and let live, a less degree of brutality in their nature, were the better able to withstand the change and to alter gradually to meet it.

With the incoming of the grassy plains and the consequent immigration of the large, grass-eating mammals, a new, and perhaps forever important food, made its appearance. Only creatures who were inclined to coöperate and who could grasp a stone and hurl it with some clear sense of direction could cope with these beasts and make them their prey.

There was a natural group that would, by its very character, tend to keep together, and join in concerted labor. This group consisted of the male, the female and the partly developed young. The family was for man undoubtedly the first unit of coöperation, as it is to-day the fundamental unit with which all our civilization seems to be indissolubly linked. While polygamy and polyandry have sprung up now and then amongst savage tribes, especially under the stress of war, the splendid work of Westermark seems to be making it clear that a tendency toward monogamy is very deep-seated, and almost certainly primitive in the human race.

It is easy to dismiss all this and to say it is pure fancy, or to use a more scientific term, nothing but an hypothesis. So it is. Most knowledge of scientific principle was come at by this pathway. Hypotheses are

not thrown out at random. There are always leadings in that direction before any scientist is induced to make one. Some facts point that way or the hypothesis would not be formulated. Gradually one of two results comes about. Undoubted facts turn up which are clearly contradictory. Then the supposition must be modified so as to embrace both the old knowledge and the new. If, more and more, well correlated facts continue to be found, the hypothesis takes definite form, becomes a theory. Perhaps after a while so many facts, new and old, confirm the theory that it is seen to be a principle. Sometimes its definiteness becomes such that it can be shown to be a universal method of action under similar circumstances. If we can formulate such a principle in definite words describing its action, we have a law of nature. We would never arrive at laws if we did not start with hypotheses.

It is a *hypothesis* that man's center of dispersal was that of a number of others of the great groups of modern mammals, the central Asian plateau.

It is a *theory* that the change of climate due to the elevation of the plateau and of the mountains led to the change into manhood of forms previously far more apelike.

It is a *principle* that changes in the environment lead to changes in the plant and animal inhabitants of the region.

It is a *law* that the changes of the past have as a whole led from the simpler to the more complex, from the lower to the higher—in a word to evolution.

With the picture drawn, many anthropologists may not agree. Some would put the home of the race in Lemuria —on the north coast of Gondwana land, by the southern

shores of Tethys—that is in land now sunk beneath the surface of the Indian Ocean, between Hindustan and Madagascar. Some others would bring primitive man from the cold north—with a volcano near by to teach him the blessings of fire. The feeling amongst American anthropologists is growing steadily in the direction outlined above. They all know we have no definite knowledge as yet. But the faith that is in them is sending expeditions into the Asian plateau, and a few years may easily give us a clearness of conception we have thus far entirely lacked. We must realize that the study of anthropology is intensely modern, and that the last twenty-five years have given us more than all the years preceding. New discoveries are now steadily being made and new materials being systematically interpreted. We may well look forward to a time not far distant when the evidence of the development of man from lower forms shall be as clear as that which has persuaded us that the earth is round, and that it has been in existence for an immense length of time. Both of these teachings were once thought impossible of belief by God-fearing men. Yet now no one thinks the first subversive of religion and few think the second to be so. Always the new knowledge seems to contradict the old, yet progressively it is assimilated, and after a while is seen not to contradict the great fundamental beliefs, but, on the other hand, to deepen and enrich them.

But what about the Java skull-cap? Where does it fit into the hypothesis? Perhaps its ancestors, too, came from the central plateau. It was a later development than the apes, sprung from the common stem higher up, a nearer parallel to man himself. But it lacked the plasticity

of the better group, the pre-human stock, and could not live in competition with it. The creature was compelled to flee before the face of man, even in his lowly form. When it migrated it went south with the conditions and landed, after passing what was then a long peninsula, but is now a chain of islands, in Java. Here was an erect but shambling creature, with head set far forward on its neck, and with low forehead. But it stood erect, and was probably taller than early man. Judging by the length of the thigh bone, it was about five feet seven inches tall. When we remember that the Java skull is generally believed to have been that of the female, this is quite tall.

IV

There has been earlier mention of the skull which Dubois built up out of his fortunately discovered skull-cap and the teeth. Of course, men are not content to make imaginary reconstructions of the bony part alone. We must have the face and the neck. Then people untrained in anatomy can get some conception of the status of the original. The scientist and the artist must combine. The scientist must furnish the data, the artist must perform the reconstruction.

The best known of the earlier attempts to restore Pithecanthropus was made by the Belgian sculptor Mascre, acting under the direction of Professor Rutot. He has given us a quite attractive bust, following well the lines of the known parts. His creation is distinctly less animal in expression than the apes, and the milder nature of even savage man is more apparent. Mascre has filled

PLATE II. THE APE-MAN OF JAVA, AS RESTORED BY M. MASCRE UNDER THE GUIDANCE OF PROFESSOR RUTOT.
Taken from *Prehistoric Man and His Story,* by F. Scott Elliott.

the arms of his statue with succulent vegetables, giving an indication of what he considers the food of this near cousin of early man to have been.

There has been a recent American attempt to reconstruct, with more definite and exact calculation and measurement, and with less left to the imagination of the sculptor, himself a scientist. Dr. McGregor, of the American Museum of Natural History, acting under the stimulus of Dr. Osborn, and with the resources of Columbia University and the Museum behind him, has made a remarkable restoration of this creature, half man, half ape. (Figure A, frontispiece.)

There is a well known picture made with much more play of the imagination on the part of the artist, and yet with much of the direction of the scientist. Gabriel Max is an artist of the Munich School. Lovers of the Metropolitan Museum of Art in New York will recall his picture, "The Last Token"—the rose thrown by her lover to a Christian maiden, a martyr, who has been turned over to the beasts of the Arena. This artist, acting on the suggestions as to Pithecanthropus made by Professor Haeckel, prepared a group picture of male, female and young, and dedicated it to Haeckel when his fellow scientists from over Europe gathered at Jena to celebrate his sixtieth birthday.

There are several suggestions in this picture that are interesting. The limbs are columnar. The wrist and ankle have not yet narrowed as the muscles retreated into the forearm and calf, leaving in their place slender tendons, and giving grace and flexibility to the joints. The male is still possessed of the mane. Amongst most mammals the male is not only stronger, but more handsome

than the female. The female here is already surpassing the male, whose mane is to grow less and less. There is a softer look on the face of the female, which is again prophetic. The cause of this greater softness is apparent. It is the helpless young at the breast of the mother. Under God, the love of a mother for her helpless child, the most utterly self-denying love in human affairs, is to be the great agent for the uplift of the race. The love of the male for the female is a far more selfish emotion, but already in this creature this love is being softened and uplifted by the example of the mother.

Just as this book is about to go to press comes the news from South Africa that Professor Raymond Dart has found there a skull which is of great age and lower in type than any yet found which is above the level of the apes. No full account and no picture is yet available. No mention would here be made of this, were it not for Professor Dart's previous experience and the fact that Dr. Arthur Keith, of London, has such confidence in Dart's accuracy as to be very hopeful.

The skull is said to have been found fifty feet deep in limestone. It is reported to be lower than the Java skull-cap, and higher than the chimpanzee. Professor Dart calls it Australopithecus africanus. He thinks he has a new link in a chain that runs as follows: ape (chimpanzee), man-ape (the new skull), ape-man (the Java find), near-man (Piltdown), low man (Neanderthal), man (Cro-Magnon). Still men ask after "missing links."

CHAPTER III

A Few Really Human Fragments

The Heidelberg jaw. Reconstructed Heidelberg man. The Piltdown skull and jaw. Restored Piltdown man.

I

In the last chapter we considered a small collection of bones, taken in a distant island, of such uncertain character that good authorities differed as to whether they were human, near human, or apelike in character. Furthermore, these bones were found so far down in the strata that if we attempt to designate any definite number of years as the time that has elapsed since they were deposited, good authorities put it at five hundred thousand years.

Now we come to two cases of bone finds, clearly from periods much nearer our own. Even in these cases there is still too little in each find to give us any full chance to build up an authentic picture of any probable early ancestor. We have the advantage here, that there is no doubt in the one case as to the human character of the lower jaw bone, which is the only part found, while in the other case a handful of skull fragments are confessedly human while a jaw fragment is debatable.

If Pithecanthropus goes back for five hundred thousand

years, Heidelberg man lived two hundred and fifty thousand years ago. Near the city of Heidelberg, in Germany, is the village of Mauer. Just outside this village there is a deposit of sand nearly a hundred feet in thickness. This bank is made up partly of wind-blown materials (loess), but chiefly of sand and gravel. It is clearly stratified, and has apparently all accumulated within the last geological period—the Pleistocene. Near the base of this deposit, about eighty feet beneath the surface, was found a much prized specimen, now in the Museum at Heidelberg.

The workmen who were employed in digging this sand were enjoined to watch carefully for any bones they might find, and were asked to use the greatest care in handling any specimens that turned up. Bones of extinct animals had already gone in considerable numbers to the University of Heidelberg, where they were studied and prized by the Professors of Science.

One day, in the fall of 1907, two diggers were working in the quarry, when one of them struck a bone. On lifting his shovel, he found on it half of a jaw bone that looked human except that it was excessively large. The man knew the value of fossil finds by previous experience, and he hunted with care for the other part of the jaw. Unfortunately the blow of the shovel had broken off the tops of four of the teeth on the left side, and these crowns were never found. The teeth on the right side, while not a little worn, evidently by the owner in his lifetime, serve perfectly to tell the entire character of the jaw. The halves of the bone could be accurately joined without the loss of any part, so that the jaw forms excellent material

for study, its structure being fully known without any possibility of misunderstanding.

The proprietor of the pit recognized the interesting character of the find and promptly took the specimen to Professor Schoetensack, of the University. He at once realized that it is an undoubted human jaw and yet as undoubtedly primitive.

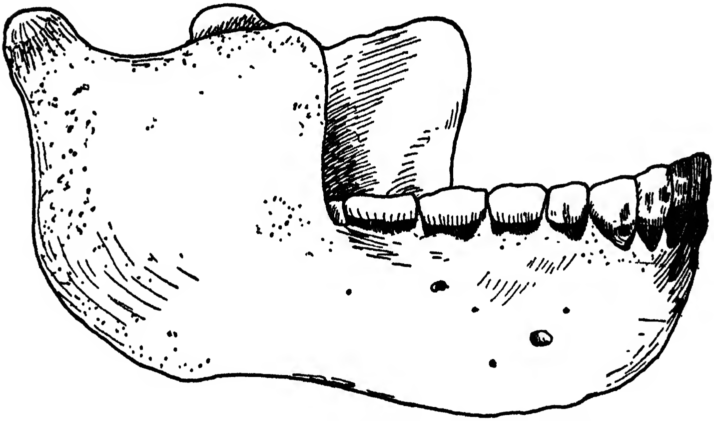


FIG. 14. THE HEIDELBERG JAW, AFTER SCHOETENSACK.

The fact that if human at all it was very early human was evidenced both by the character of the jaw itself and by the depth beneath the surface at which it was found. The most striking feature of the Heidelberg jaw is its enormous size. It is about one-fourth larger in most of its dimensions than the jaw of the modern white man. The great width of the ascending wing, serving for the attachment of the muscles used in chewing, shows that the owner of this mandible had a most powerful grip between his teeth. The canine teeth in very many mammals,

including the monkeys and the apes, project far beyond the tops of the other teeth, giving the animal the power to sink its canines into the body of its enemy, hold with prodigious power, and tear the flesh vigorously. In the Heidelberg jaw there is no such protrusion of the canine teeth beyond the rest. Thus far, while the size is certainly exaggerated, there is nothing which is not clearly human, particularly in the teeth. There is, however, one peculiarity of the jaw which is quite unlike that of modern man, and in this respect it is distinctly more apelike. There is no chin. This feature is an apparent addition to the modern jaw, on which great stress has been laid by some anatomists, as if it were a feature on which we had good reason to pride ourselves. In itself, it is no addition. It only means that as the front teeth in the human jaw became more erect, and the size of the jaw diminished, often so much as to overcrowd the teeth, the bony lower portion of the jaw has not shrunk as rapidly as the more spongy upper portion in which the teeth are set. Hence the lower part of the jaw protrudes, forming a chin.

Thus far we have said that the Heidelberg jaw is quite fully recognized by anatomists as being human. But it may have been human without being the jaw of one of our ancestors. Slowly the tide of opinion seems to be turning to the side of those who say it was not. We will later come to know Neanderthal Man, and to find that, while he was certainly a true man, he lay outside the ancestry of the men of to-day. He was thus a representative of a side line that has since become extinct. It is the opinion of most of our anatomists that Heidelberg man was not the ancestor of man of to-day (Homo

sapiens), but that he lies in this Neanderthaloid side shoot, that has completely run out.

Dr. Sollas, of Oxford University, has a fascinating theory that we may find recent representatives of early man in out-of-the-way corners of the earth, where they have been driven by their more successful cousins. Perhaps sometime we will connect the most primitive section of a primitive people, like the Tasmanians, with the earlier types of men like the one who once owned the Heidelberg jaw. Until we find more of the skeleton of Heidelberg man, it is vain to speak of his general body form. The skull-cap of Java man, without the jaw, gave us a better means of judging the character of the head than does the jaw alone of the Heidelberg man. A few points, however, are clear. He must have had a powerful muzzle. His teeth are very much worn. Perhaps, like the Eskimos, and some of the Australians, he did much work with his teeth, including the dressing of the skins of the animals he had killed.

We may judge of him further by the company he kept. At the same level in the bluffs of sand in which the jaw was found, there was also present a variety of the bones and teeth of other animals that tell an interesting story. The climate must have been warm and moist. This would indicate one of the warm intervals between two of the great glacial advances, probably the second interglacial. In this period the neighborhood of Heidelberg must have been covered with a rather dense forest. Amongst the trees roamed early types of such southern animals as the elephant and the rhinoceros, while nearby the more northern types of now extinct bears and of bison and oxen and wild boars.

In Mascre's restored bust of Heidelberg Man we have the same bland expression by which he always differentiates his men from the beasts. The head shows well the terrifically heavy, chinless jaw, together with the cheek muscles necessary for its effective use. The eyes have the ridge over the brows and the retreating forehead with which we became familiar in the Java skull. Here they are less marked than in that surely not more than half developed man. They will grow less when we come to know what was most probably a descendant of the man who carried this jaw, namely Neanderthal Man. Over his shoulder Mascre makes him carry a dead boar, which doubtless has fallen at his hands. This was no mean victory for a man with weapons as primitive as his must have been, if, indeed, he had any. The only evidence we have of their possible character lies in the presence in deposits of this age, of those doubtful fragments of stone that are known as eoliths (dawn stones). If these are artificially flaked stones, the flaking is as yet very unskillful. It is clearly Rutot's conception that the Heidelberg man used the sharp edge of such a flake to scrape to a point a hard piece of wood. This crude weapon has, under the stress of the heavy muscles of the arm, penetrated a vital spot and killed the boar. All of which is quite interesting and may be true.

A hundred and fifty years ago the Swedish botanist, Karl von Linne, better known to students by the Latinized form of his name, Carolus Linnaeus, taught scientists to aid their work of classification by giving to each animal or plant two Latin names. The first of these is the name of the genus, or group of animals not of quite the same kind, yet very much alike. Then all of the same kind

made up a species and had the same second name also. To the scientist, much of his position on certain problems can be expressed by the name he assigns to his newly discovered animal or plant. While Schoetensack believed Heidelberg man near enough to modern man to be put into the same genus, and hence to be called, like him, Homo, he realized he was not identical, and hence could not be called, like modern man, Homo sapiens. So he called him Homo Heidelbergensis. Bonarelli, wishing to emphasize the distinction involved in the heavy wing of the jaw and the lack of chin, called him instead "The Ancient Man of Heidelberg," Palaeanthropus Heidelbergensis.

II

Just as Heidelberg man came in time, half way between the Java find and to-day, so our next oldest find halves the remainder of the interval. The Java skull is said to be five hundred thousand years old; the Heidelberg jaw is, on the same count, two hundred and fifty thousand years old. About one hundred and twenty-five thousand years have elapsed, if the students of anthropology are right, since the owner of the Piltdown skull hunted his food along the rolling hills of what is now Sussex, one of the southern tier of counties of England, facing the English Channel.

The Piltdown remains are amongst the most recent of important finds made by the students of primitive man. Soon after the discovery of the Heidelberg jaw, a Mr. Charles Dawson was walking along a Sussex road when he noticed that the road bed had been mended with earth

containing brown flints, which were not common in that neighborhood. He found that the material used in these repairs had been dug from a gravel bed on a near-by farm. He asked the workmen whether they had come across any fossils or bones of any sort, and they said none such had been found. He then cautioned them against injuring or missing anything that might be there and went his way. On a later visit one of the workmen showed him what Dawson recognized as a part of a very heavy side bone (parietal) of a human skull. He looked carefully amongst the loose material scattered about and found no companion bone. He continued to visit the spot, hoping for further traces, but found none for several years. In the fall of 1911 his patience was rewarded with a second bone, a part of the forehead and the ridge over the left eye. As in the case of the Heidelberg jaw, the workman had a realization of the possible importance of the find and took it to a scientist. This time the find came to Dr. A. Smith Woodward, of the British Museum. In the spring of 1912, Woodward and Dawson undertook a careful and systematic search of all the loose material in the pit, digging and sifting over all the previously loosened earth that was lying about, and then continuing work on the gravel pit itself. It was evident that the skull had been shattered by one of the workmen and most of the fragments had been thrown away, the only bone which had then attracted attention being the side of the skull previously mentioned. Careful sifting and close examination of the fragments of the rock, which were colored so like the bone as to make detection of the latter difficult, resulted in the finding of a number more of the fragments of the skull. In addition to these, they

uncovered, in the undisturbed portion of the gravel, a broken right side of the lower jaw bone, and near it a portion of the lower rear part of the skull (occipital). These bones were clearly old. They were five feet beneath the surface of the ground, and in a sort of material that would have plainly shown the fact, had the skull been buried. In addition, there were portions of the teeth of an elephant, of a mastodon and of a hippopotamus. In the same layer were a number of pieces of stone, eoliths, which may have been worked by human hands. Higher up in the pit were found several undoubtedly artificial stone implements, but they were probably of a later date (Chellean). The teeth mentioned were broken and rubbed. They had evidently been rolled by water and left here with the other gravel. The human bones had not been rubbed by transportation. So the skull was evidently older than the flint implements, but not so old as the time when the elephant, the mastodon and the hippopotamus lived in England. It is this evidence on which the age of the Piltdown man is based. He plainly lived in the age of the glaciers, but in one of the warmer intervals; anthropologists now think the third interglacial, perhaps one hundred and twenty-five thousand years ago.

These fragmentary remains of a skull have naturally been the subject of much discussion. Every one agrees that the bones of the skull case are human. The lower jaw has been the subject of much contention. All agree it must have lain beside the skull for ages. Its rear end seems to fit the depression in the skull as it should. The character of the skull is so remarkably modern in its general shape and the jaw bone is so primitive that many competent authorities have contended that the jaw is

that of a chimpanzee, which they name Pan vetus, though never before has any ape or even monkey been found in England. Slowly, however, more and more students seem to be agreeing that the whole collection is a unit and represents a clear ancestor of man as he exists to-day.

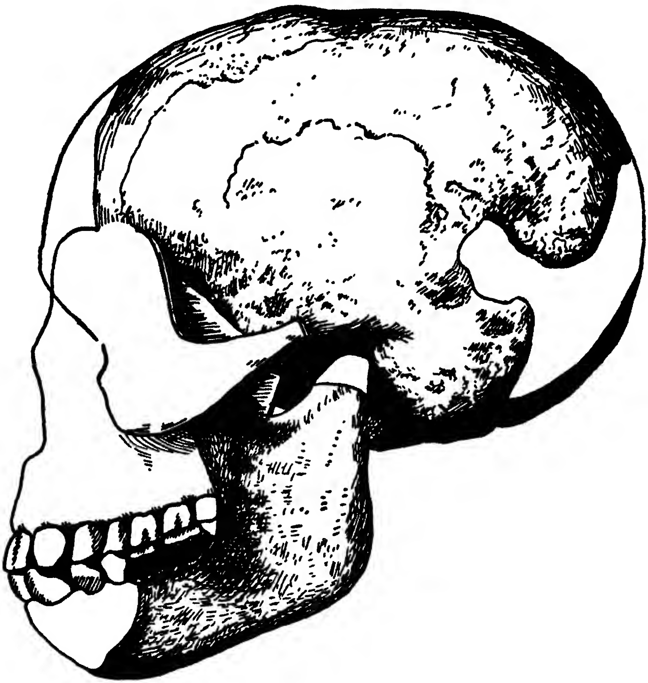


Fig. 15. The Skull of Piltdown Man, as Restored by Dr. Woodward.

The fragments of bone prove to make up between them four of the bones of the skull. There are open spaces where bones are wanting, and it is exceedingly difficult to tell just how far apart these fragments should be

placed. This makes it difficult to say just how big was the brain which they enclosed. All estimates agree sufficiently to make some facts about Piltdown man quite sure.

The skull has a reasonably well-shaped forehead, without the big eye-ridges which we saw in the Java skull and with which we are to become very familiar in Neanderthal man. The forehead, while rather well arched, is not high, and the rear part of the skull is particularly low. The ridges on the temples, where the jaw muscles were fastened, are so marked as to point to a very strong jaw and a powerful bite. The brain in all probability had a capacity of more than a thousand cubic centimeters, perhaps of twelve hundred. The average American has about fifteen hundred. Professor Keith, of the Royal College of Surgeons in London, and an excellent authority, says that, while in a few respects somewhat primitive, the brain of Piltdown man was so essentially like our own that it "responded to the outside world as ours does. Piltdown man saw, heard, thought and dreamt much as we do. If the eoliths found in the same bed of gravel were his handiwork, then we can also say he had made a great stride towards that state which has culminated in the inventive civilization of the modern Western world."

And yet, if this creature had the jaw which was found with his skull, he was not by any means the type of modern man. The jaw, if found alone, would certainly be attributed to an ape, yet it seems to belong to the skull. If all these bones were once the property of the same individual, then it is clear that at least in this branch of the human stem, the brain and its containing case evolved much more rapidly than the jaw which is here still entirely

without a chin and undoubtedly was once provided with massive jaw muscles. While the skull shows such form as to make us believe Piltdown man lay in the direct ancestry of man to-day, his jaw shows that he had not yet arrived. Accordingly scientists are agreed to call this man "Dawson's Dawn Man" (Eoanthropus dawsoni). Some anatomists insist, however, in separating the jaw from the head and calling the owner of this primitive and broken mandible "The Ancient Chimpanzee" (Pan vetus).

Most of us are not accustomed to judging people by their skulls, because we rarely give more than a cursory glance to a skull in a museum and almost never see one elsewhere. If we are to get any clear idea of the head, we must have some student who has knowledge and skill in such matters clothe the framework with its wonted covering. Dr. McGregor, in the course of his studies for his Piltdown bust, has given us a striking sketch of this not quite man, this "dawn man," whose capacity for thinking seems to have far outrun his skill in execution. This is still not quite modern man, but it is on the straight road. We have progressed steadily upwards. We began with the "ape-man," we went on to the "ancient man," we have just seen the "dawn man." The stage is set for the appearance of Man (Homo), though not for many thousands of years will we see the "wise man" (Homo sapiens).

CHAPTER IV

What are Eoliths?

Man's body is perishable. Flint implements are very durable. The first implements are hard to recognize. Later they become clear. Does man go back as far as these Eoliths?

I

In the preceding chapter we have been trying to trace back as far as possible the evidences of man's long life on the earth. In so doing, we have been studying the most conclusive of evidences, an actual part of man himself. The body, which serves man so well during his life time, does so only by its own steady destruction. All the power, by which man performs the movements of any of the organs of his body, comes from the slow combustion of his muscles. His body, or his blood, is being steadily consumed in the production of heat and of motion. When he dies, the wasting of his tissues continues, the process of decay being a slow combustion. An Egyptian Pharaoh may so impress his subjects with his importance that they may wrap his body in preservatives and close him up in a stone coffin, sealed in a stone vault, under a great stone pile, and delay for a few thousand years what would otherwise have been accom-

plished in a far shorter time, but in the end the result is the same. The body slowly turns, by various steps, into carbon dioxide, water and ammonia. These are handed over to the world of green plants to remake into foodstuffs, which shall again furnish power for the activities of plant and animal life. But the body has a framework which is not thus consumed. This is already partly fossilized by the deposition of phosphate of lime in certain of the tissues, converting them into bones. Some, like the bones of the skull, serve to guard delicate tissues, like the brain, from the shocks and accidents of life. Most of them, however, serve to stiffen other parts. For example, the backbone makes it possible to stand up without the support of surrounding water. In still higher animals these bones serve as levers by which motion from place to place is carried on, or work in the fashioning of his utensils, the hurling of his weapons, or the cultivation of the ground is accomplished. When tissues have lime enough in them to serve such purposes, they are very much slower of decomposition than are the other parts of the body. Hardest of all the tissues of the body, because most compactly filled with lime, are the teeth, which must be hard enough to stand the very frequent grinding of the food through all the days of the entire life time. When we consider that the fossils we find are often many millions of years old it is not strange that most of our knowledge of animals of the past should be restricted to an acquaintance with their skeletons. We may, by comparison with living forms, build up in our imagination the appearance of these creatures of the past, but our accurate information is confined in most cases to the bony framework.

This is quite as true of man as it is of the rest of the animal world. His fleshy portions soon decay. Long after these, as well as the vesture in which he was clothed, have entirely disappeared, the bones and especially the teeth are still to be found. If the body becomes enclosed in mud or clay or in dry wind-blown earth, this framework may last for a very long time. The students of anthropology hope that somewhere, at sometime, they will fall upon such skeletons, complete and durable, for the earlier stages of man, and even of half-man. Doubtless such skeletons are still existent. Let us hope they will someday be uncovered by men who know their value and will exhume them with all the precautions that will preserve them completely and, at the same time, disclose all such evidence as the surroundings afford, of the period of the earth's history during which the creature lived. We always want to know also the character of the weapons and utensils he had learned to make and use, and the animals that served him for food, or battled with him in the struggle for life.

More durable than any part of the human body are many of the minerals. Not all stones are imperishable. In the course of time the weather will disintegrate slowly many minerals. Amongst those that are most imperishable are the various forms of quartz. The opaque form of this mineral, commonly known as flint, has proved very useful to man. When struck a blow, flint usually breaks along more or less curved and commonly quite smooth surfaces. The edges are often very sharp, and retain their form well under considerable use, if care is exercised not to strike them against other stones. This has made flint the favorite material all over the world,

in localities where it is present or from which it is not too far absent, for the manufacture of the weapons and tools of early man. Such implements have been found by the many thousands. No center of modern culture is so old but that we find in its neighborhood stone implements that are older. It is usually perfectly easy to recognize that these have been made by man. We never are tempted to imagine that any other animal has had ingenuity enough to make them. Whenever we find them we feel sure man has been. If they are clearly part of a stratified deposit, we are quite sure man has been in the near neighborhood at least as long ago as the formation of that deposit. Naturally, the farther down in the strata we go, the more likely we are to find that these implements are crude. We realize certainly that we must finally come back to a time when man was not far enough advanced to do more than pick out pieces of stone that served his purpose, exactly as a boy does when he is gathering chestnuts. Often near a chestnut tree we find a very suggestive group of objects. The top of a buried rock projects out of the ground. About it lie chestnut burrs. Beside the buried stone, that has evidently served as an anvil, is another rounded stone. One edge of it has many of the small white spots that show where the stone has struck another stone. The top of the projecting stone shows similar bruises. The story is so plain that we have no doubt as to its meaning. The boys have been gathering chestnuts. The burrs had to be pounded open. A stone nearby was of such size, weight and shape as made it a suitable tool for the purpose. The convenient anvil was also near at hand. Perhaps, one

day's chestnutting is all the boys contemplate. The stone hammer was easily found and easily replaced if lost, so no attempt was made to keep it. Doubtless primitive man, when he had become sufficiently developed to realize his needs and his opportunities, did as the boys now do who hunt chestnuts. These boys, however, had at home tools for most of their work. Remember, man at first had none, and he gained his experience doubtless with painful slowness. He must gradually have come to the time when, if he had found a stone that suited his purpose well, he kept it about him. Experience taught him that some kinds of stone lasted longer without losing their form under use. Doubtless, too, after a time, and it seems, indeed, as if it were only after a pitifully long time, he realized that he could often improve the shape of his stone by knocking off corners or edges. His few needs were met by a few implements. Stones of certain shapes would naturally come to be used, and these shapes are so frequently found as to be recognizable now.

For a long time the flaked implements, recognizable as artificial by any observer, even though he be entirely unaccustomed to such specimens, have been known as palaeoliths (ancient stones). For the earlier fragments of stone, partly natural and partly artificial, often so nearly natural as to make it hard to believe they are at all artificial, the name of Eoliths (dawn stones) has been proposed.

II

For a long time there has been a battle over these Eoliths. Some archaeologists have been certain on the

one side that they are very abundant and run very far back into the past. Other men, of undoubted experience, have been distinctly skeptical concerning the matter, declaring that if there are eoliths no one can tell them from naturally fractured stones. Men who hold this opinion have gone to piles of stones of undoubtedly natural fracture, at the base of cliffs where water has battered the stones about. Particularly they have gone to situations in which fragments of stones lie on slopes such that there is a quiet and steady creep of the pile, under pressure of the weight of the material above. Under such conditions there is no doubt that it is quite possible to find occasional stones so formed and fractured as to look almost exactly like stones which are accepted by most authorities as genuine eoliths.

An almost amusing but entirely valid piece of evidence against eoliths was adduced by one of the doubters. At a cement factory he found that the chalky material, freed from all large nodules of flint, was rotated in a mill to make it fine. They never successfully removed all the flint previous to milling it. When the material was removed from the revolving cylinders and the flints, which had been repeatedly bumped against each other, were screened from the fine chalk, this observer found amongst these flints hosts of specimens that would have made a "superb" collection of eoliths.

All of this shows that it is clearly difficult to tell whether or not a stone is a true eolith. It is more than possible that many of the so-called eoliths, collected by experienced observers, may never have touched the hand of early man. In spite of all this, students of archaeology

are, more and more of them, coming to accept the idea. One of our very capable American archaeologists, Dr. MacCurdy of Yale, went to Europe dubious and came back convinced.

When I obtained my own specimen of this sort, the scientist who handed it to me said, "Here is an eolith if there are eoliths." I picked it up and glanced it over.

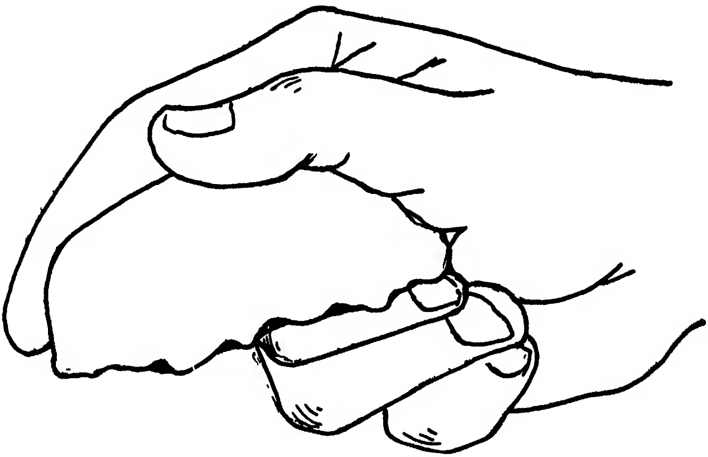


FIG. 16. EOLITH IN HAND, AUTHOR'S SPECIMEN.

I accepted it for what it might prove to be, but I certainly doubted whether man had ever had anything to do with it. Later, as I examined it more carefully and realized that some of the nicks were probably like those in an old hatchet due not to intention but to use, and found how excellently the stone fitted my right hand, the specimen became more interesting. After comparing it with others in the Museum, I am a convert to my eolith.

III

In deposits near Chartres in the valley of the Seine Desnoyers had found a bone of the mammoth—the king of all elephants and long since extinct—on which were a number of scratches which he thought must have been made by the teeth of some animal not unlike the present beaver. In this same locality, and at the same level, but at a later date the Abbe Bourgeois found fragments of flint with the flakings and shapings that seemed to point to intelligent purpose and hence to man. This led to the belief on the part of the finder that the scratches on the bone were the work of human hands, as were also the eoliths.

These fragments of flint were taken to a meeting of the Anthropological Congress at Brussels. Here a committee of fifteen men examined the specimens. They reported that a majority of the committee, including the well-known de Quaterfages, believed at least some of them to be genuine. It was their belief that if these specimens had been found in Quaternary deposits no one would have doubted them. A third of the committee, including Professor Virchow, who persistently objected to all the evidence in favor of the evolution of man, denied the authenticity of the specimens.

In Southeastern England the valleys of the rivers show the terraces so common along streams, especially in the region once covered by glaciers. The gravels of such terraces are the resting place of very many of the implements once used by primitive man. Among the collectors in the county of Kent was a Mr. Benjamin Harrison. He was an enthusiastic student of the axes and knives

belonging to the Palaeolithic Age. Working up the sides of these river valleys, he finally passed over to the level of the plateau. Here he found abundant eoliths strewn along the furrows made in the surface by the plow. Later digging showed them to be distributed through the upper soil, though more than a man's height below the surface.

Similar specimens have since been found very abundantly, and are sufficiently recognized now to be generally accepted, at least when found in the deposits of the Pliocene and Pleistocene Age. There is amazingly little advance in workmanship in the later specimens over the earlier, even when these later examples are found with other and far higher implements. Stone age man never gave up making and using these flint chips. They had their place for certain uses when much more elaborate implements were made for special purposes. This is an exact parallel with the fact that even on farms where there is a reaper and binder we still find a sickle and where there is a gasoline driven saw we still find the axe.

IV

A very early eolith, if it is really one, is represented in Figure 17. This is the sort, concerning which there must always be an element of doubt. It comes from so far back that it is hard to believe man could have made it and still harder to believe anything else, unless indeed half men could have done so.

Figure 18 shows one of Harrison's Kent eoliths. These seem to be impossible to doubt and yet they are earlier

than any actual human remains which have yet been found.

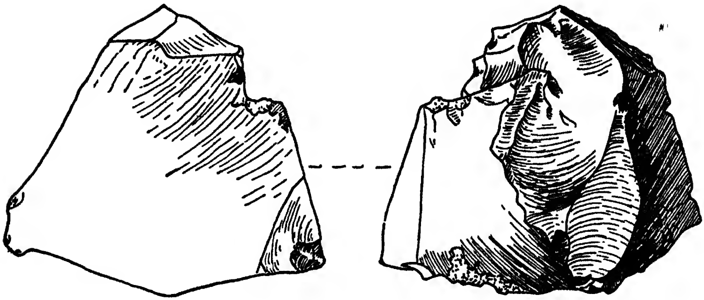


Fig. 17. Eolith from Tertiary of France, after Verworn.

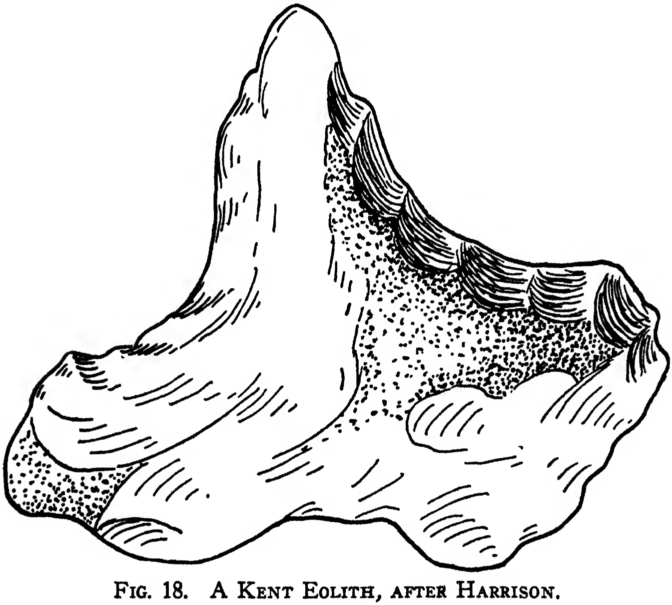


Fig. 18. A Kent Eolith, after Harrison.

It seems certain, if man has developed with time—and all his works show that he did—that we must expect

these doubtful forms at the first. Man unquestionably picked up stones that served his purpose. If one served particularly well he kept it, at least for a time. Such a stone would show marks of use. Two sorts of imple-

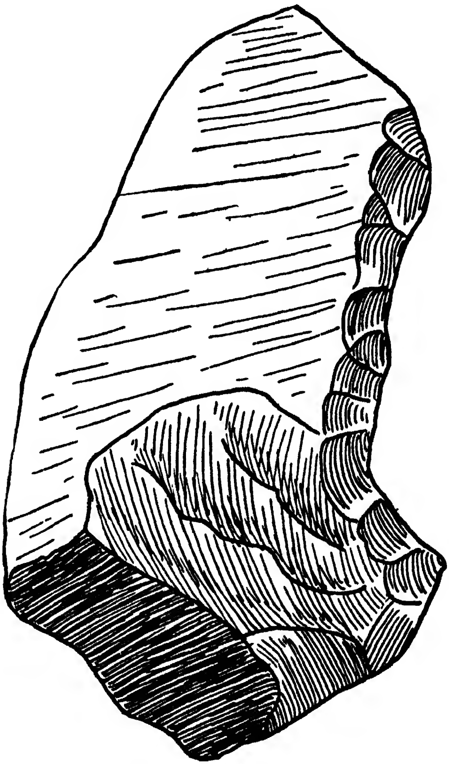


FIG. 19. A TASMANIAN EOLITH, AFTER NOETLING.

ments he certainly needed and used, namely, hammer and knife. The latter term is almost too definite and implies too sharp an edge. The earliest implement of this type

served indiscriminately for purposes for which we would now use knife, saw, and scraper.

After a time man doubtless found that by knocking one stone on another, especially if both were flints, that pieces would fly off. Some of these pieces had a sharp edge and served his purpose well, though most of the fragments were useless. Time brought experience, though very slowly. He learned to sharpen one side for the work, and to smooth the other side to his hand. A still higher stage was reached when very light taps, perhaps even only pressure, made small chips fly from the already roughly sharpened edge. There is little doubt left that these are eoliths. They are abundant, running on to all later periods. and were found in actual use when the white man first came in contact with the Tasmanians, in the last century.

When these so-called eoliths are found with other implements, they are easy to credit. Where the other implements begin to fail as we go back, certainty becomes more difficult. When they go to the earlier Tertiary it seems impossible to believe them.

There was a great cornetist in my youth who occasionally closed the rendition of a selection with a long-drawn note which grew steadily fainter and fainter until at last it could no longer be heard. It was said he was quite in the habit of maintaining his attitude of blowing, after he had really ceased. He stood silent, but so long as he held his cornet to his lips his hearers prolonged the note in their imaginations.

It is hard to believe that anyone is sure just how far back these eoliths were truly artificial and when man-made flakes end, and only natural flakes, never used by early man, are all that can be found.

CHAPTER V

Dating the Work of Primitive Man

A Palestinian series of cities. Similar stations of early man. The ages of man judged by his implements. The dawn of the stone age. The Lower Old Stone Age; Chellean, Acheulean, and Mousterian implements. The Upper Old Stone Age; Aurignacian, Solutrean, and Magdalenian remains. The New Stone and the Metal Ages.

I

Visitors to Rome, who are not prepared beforehand, are surprised when they come to the Roman Forum, to find that although the city has been continuously occupied since its foundation, the Forum had become completely buried. Only within recent times has it been cleaned up, so that visitors may see the early "center square" of the ancient city. It is thirty or forty feet below the level of the modern city.

The students of the civilization of the Tigris and Euphrates valleys and of the dry eastern shores of the Mediterranean, are quite accustomed to find layer after layer as they dig down. Each layer represents a group of inhabitants earlier than the layer above and later than the layer beneath.

The University of Pennsylvania has a party in the field, under the leadership of Dr. Clarence S. Fisher, digging through such a series of cities and bringing the evidences of these successive civilizations back to the University Museum. Here these transported treasures illustrate the history of the past and permit students in the west to study at home the civilizations of the Orient.

On a hill overlooking the Jordan Valley, and hence in fine strategic position, they found evidences of ruins. The first level which they cleaned up proved to be of the time of the Crusades about a thousand years after Christ. Three feet below this was an Arab town whose characteristics seem to place it at about six hundred A. D. Below this was the more pretentious ruin of a Byzantine church about a hundred years older. Still lower than this was a square church of earlier date, which had at least in part furnished the stone for the Byzantine church. But we are still far from the bottom. Underneath the square church was an old Roman Temple whose date, indicated by coins in its treasury, must have been about three hundred years before Christ. Beneath this heavy stone structure were the traces of mud huts such as the Scythians used. Still lower a building made of sunbaked mud bricks was found, believed to go back for more than a thousand years before the Christian Era. An exploratory shaft sunk in the floor of this building and running down fifty feet passed through a number of more primitive cultures finally reaching back to the Stone Age.

This is an unusually full series of levels, many of which can be dated by our knowledge of history. In the

debris on the sides of the river beds of Western Europe, dated roughly as related to the ice ages, by the order of the terraces on which they lie, and on the floor of caves in the mountain sides of France and Spain, similar successions of layers tell a similar story of past cultures, and help us put them in order. These are the many locations occupied at intervals almost through ages by primitive man. At St. Acheul in France is a gravel pit whose lower layers yield hand axes of Chellean times. Above these lie the layers of earth bearing implements clearly belonging to three other of the six great periods of the Old Stone Age. At, or near the surface, are found the products of the New Stone Age. Here within about forty feet of depth we find represented a span of history covering at least one hundred thousand years and perhaps twice that much time.

No one location ever shows all the periods in succession. Those that are present are always in the same order. So by combining all the locations it is possible to make an ideal section which covers the entire history of prehistoric man.

All the earlier forms are found in river gravels. Early man was compelled to live near the water. The absence of pottery, and of ingenuity developed enough to make water tight skin bags, made it essential that he should not wander far from the stream from which he drank.

His weapons—at least those of stone—are very durable. In spite of flood and storm, of freezing and of thawing, we have his implements by the thousands.

The conditions under which these are found are very unfavorable to the preservation of his body, especially

before he thought enough of his dead to place them safely in the earth.

With the oncoming of the last great glacial wave of cold, man took to the shelters and caves along the river bluffs. Here conditions for preservation of his remains were much better, and from this time on, his bones as well as his implements are found.

The preceding chapter tells of those earliest fragments of stone, at first purely natural, later with touches of human alterations, and lastly quite adequately fashioned. Such beginnings of implements are now found very widely distributed over the world. It seems as if nature taught men to make these without learning from each other, since the Tasmanians made them up to within the memory of men still alive. The same is true of the much more artificial early hand axes. All over the world inhabited by early man there are very similar forms of this simple implement. It seems as if the very accidents of life were enough to teach a creature of intelligence, no matter where he lived, the same lesson. When we study implements higher in the scale, though having a general similarity, these have local variations which show that they sprung up from the same basis but that local needs, and perhaps even more, local materials, helped to fix different varieties of the general plan in different regions.

We give the name of archaeologist to the man who studies the works of prehistoric man, as we give the name of anthropologist to the student of the actual remains of man himself, or of the physical characters of man of to-day, while the ethnologist studies present peoples, their manners, customs, and languages. The archaeologist early discovered that as he went back in

the history of man he could distinguish a difference in the material of the implements he used. Historic man made use of iron. When we get to the early boundaries of history we find bronze preceding iron. Still earlier his tools and weapons were made of stone. So the prehistoric story was written in three great chapters, the Stone Age, the Bronze Age, and the Iron Age.

Soon it became evident that there were two very natural divisions of the Stone Age. In the earlier, all weapons had rough surfaces. No matter how skillfully they were made, the surface showed faces, each due to the forcible removal of a flake of stone. Many of the later implements, after such flaking, were, at least in part, ground smooth, evidently by rubbing with sand and water, against another stone.

So the next step was to divide the Stone Age into two sections, the Old Stone Age and the New, or the Palæolithic and the Neolithic.

With the growth of our knowledge it soon became clear that the old stone age was exceedingly long and that it was quite easy to divide it into an earlier and less skillful time, and a later and quite artistic time. So we distinguish between the Lower Palæolithic, and the Upper Palæolithic. The anthropologist has found that the man of Lower Palæolithic times in Europe was probably not the ancestor of the man of the upper series, who came in from outside and brought with him a new culture.

As students grew more keen and the discoveries became more abundant and were more fully described, it became easy to distinguish three periods in the lower and three in the upper Old Stone Age. So we now divide

human pre-history into the periods indicated in the following table:

The Iron Age.
The Bronze Age.
The Stone Age.
  The New Stone Age—Neolithic.
  The Old Stone Age—Palæolithic.
    The Upper Old Stone Age.
      Magdalenian.
      Solutrean.
      Aurignacian.
    The Lower Old Stone Age.
      Mousterian.
      Acheulean.
      Chellean.
      Prechellean.
  The Dawn of the Stone Age—Eolithic.

The last two places in the table are most indefinite and perhaps each of them is longer than all preceding it.

Since Charles Darwin persuaded the scientific world of the truth of evolution we have become accustomed, in many branches of study, to begin at the bottom and work up. This is true, not only in the study of the classification of plants and animals with which Darwin specifically dealt. The geologist and the archaeologist follow the same course. Having paid a little attention in the preceding chapter to the Eolithic and its transition through the Prechellean, the balance of this chapter will be given up to a consideration of the typical implements in each of the divisions of the Age of Stone.

THE OLD STONE AGE

Chellean. The lowest of the definite subdivisions of the lower Old Stone Age is known as the Chellean, because its well known and most characteristic forms were first

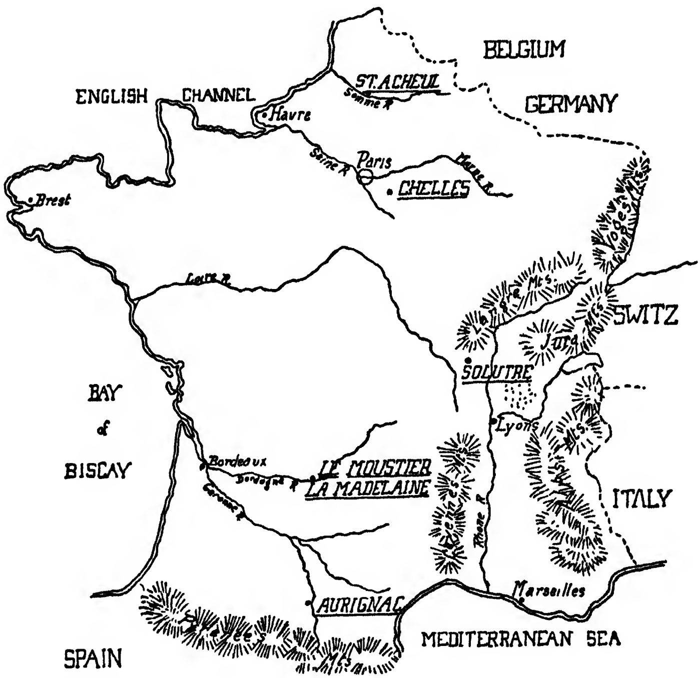


FIG. 20. MAP OF THE TYPE STATIONS OF THE OLD STONE AGE.

found in a pit of sand and gravel at Chelles on the Marne, a little east of Paris. In this pit there are human implements at four distinct levels. The lower two are Chellean, indicating a great length of time for the duration of this epoch. Above the two Chellean layers are the

Acheulean and the Mousterian. So we have here well represented the entire lower half of the Old Stone Age, beginning at least one hundred thousand years ago and running down through seventy-five thousand years.

It is clear from the animal remains found with these implements that these Chellean men lived in a mild and gentle climate. The mammals of this time are closely related to those which to-day occupy Southern Asia and Africa, though the exact species are in most cases no longer living. The straight tusked elephant, and a rhinoceros, as well as an hippopotamus, are inhabitants of Europe at this time. All of which indicates that we were here in an interglacial time, when the ice had receded and the plants and animals of a warmer environment had returned.

There is a striking uniformity in the implements of this time. There is of course a continuation from the transition times of scrapers and borers that are little more than eoliths. One implement, however, is abundant and characteristic. It seems as if man had at first used a stone, picked up because its natural shape was suitable for his purpose. In use, flint was the most satisfactory because the hardest and most durable. Fortunately the structure of flint is such that, when fractured by a quick blow against another hard object, it breaks in curved flakes, leaving quite frequently a sharp edge. These flakes doubtless at first were accidentally detached, owing to the use of the implement. Later, however, man realized that he could fashion a far better tool than he could find. He soon came to a form which so satisfied his simple need that it continued with only very gradual improvement for many thousands of years almost with-

out important additions of any other form. This characteristic Chellean implement has come to be known as a hand axe. It is what has been frequently described as almond shaped. My own specimen was found at St. Acheul and is very characteristic. The material is gray flint with darker mottlings and white patches. The axe

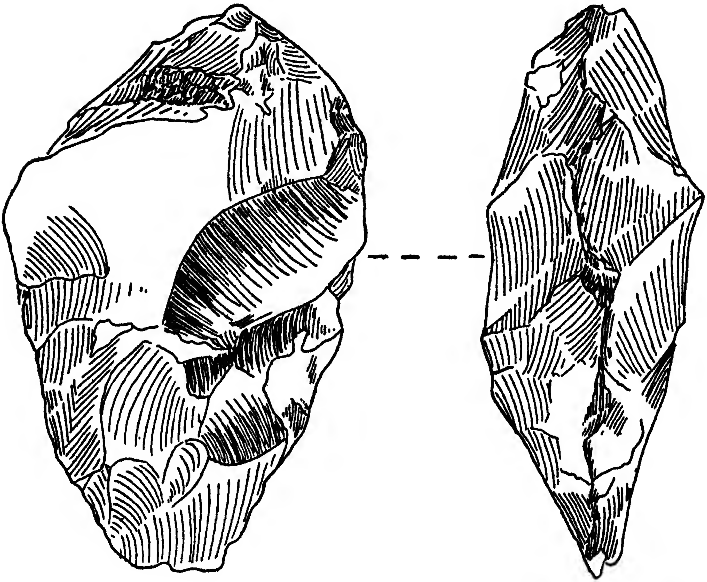


FIG. 21. CHELLEAN HAND AXE—AUTHOR'S SPECIMEN.

is four and a half inches long, three inches wide at the widest part and a little more than an inch in its greatest thickness. The flakings are of very unequal areas. The axe, looked at on the face or on the edge, is only moderately symmetrical and the edge is quite sinuous. At several places the old exterior of the flint is still present. All of this points to rather early Chellean. As the

period grows later the flakes grow smaller, the shape becomes more symmetrical and the edge approaches a line.

This Chellean hand axe must have served many purposes. It was an axe for chopping trees; it was a dagger in killing animals; it was a skinning knife for removing the hide of a slaughtered beast

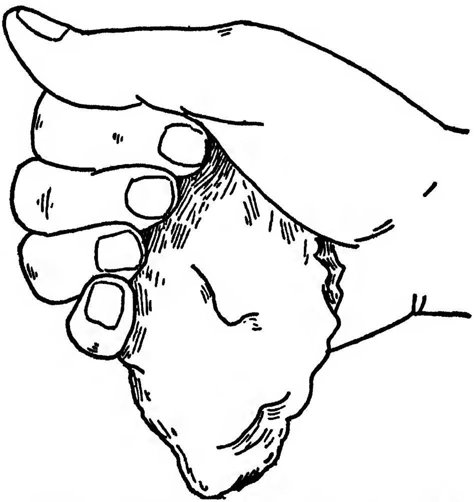


FIG. 22. CHELLEAN TOOL USED AS AN AXE.

Not unnaturally, the flakes of flint that were the by-product of the manufacture of these axes became themselves used for scrapers and small knives. There gradually came to be some additional shaping of these flakes but the main skill was expended on the core itself.

Acheulean. This epoch is named for the great locality, St. Acheul. As time went on the hand axe slowly reached a greater perfection. When we come to the upper layers

of the Chellean we find the transition to the Acheulean very gradual, there being no well defined line.

My own specimen is really late Chellean but is nearly as perfect as Acheulean and is truly beautiful. It is made of rather translucent light grayish flint, almost an agate, showing marking of brown, of white, and of blue. The flakes which were driven off in the making were small and carefully considered. The form is very symmetrical and the edge has very little wavering to its line. It is three

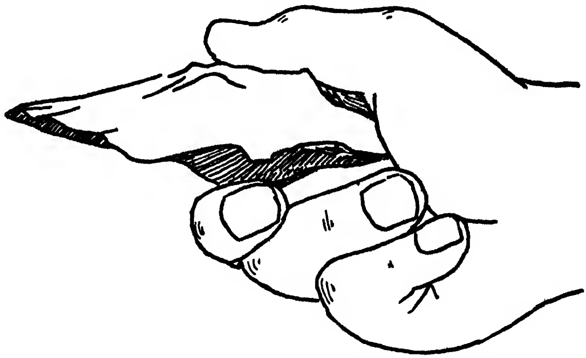


FIG. 23. CHELLEAN TOOL USED AS A DAGGER.

inches wide, four and a quarter long, and an inch thick. It must have demanded a considerable amount of time and skill in the making and may well have been prized after its completion. By full Acheulean times the late Chellean symmetry and edge became common, and the variety of forms of the hand axe became greater. Sometimes the dagger form is emphasized and the axe becomes long and narrow, terminating in a sharp point. Occasionally, in England, specimens have been found in which, quite evidently, Chellean man had made an axe and lost it.

Later an Acheulean found it, brought it up to date by additional flaking along the edges, and in his turn lost it. It is an interesting coincidence that I had in my possession, some time since, an American Indian's stone axe, which some white finder had sharpened, evidently on a grindstone.

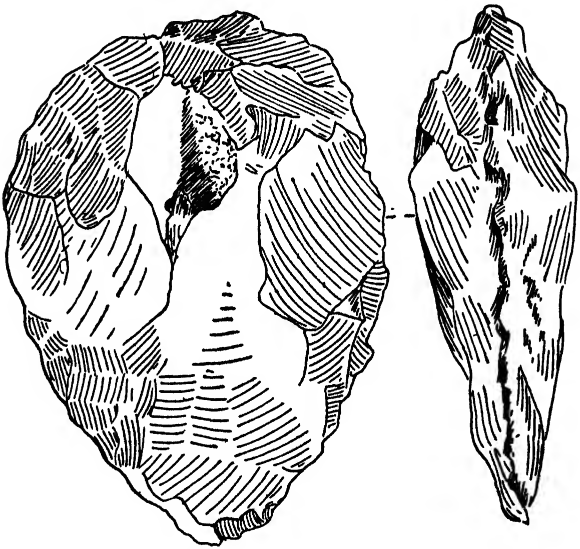


Fig. 24. Upper Chellean Hand Axe—Author's Specimen.

As we approach the next period we find the attention of the worker is more frequently devoted to the more careful retouching of the flakes that were knocked off, and this is prophetic of the development of the next epoch.

Mousterian. The Mousterian is the uppermost of the epochs in the Lower Old Stone Age. Its work is so much advanced over the hand axe of the Chellean times that

some authors call this the middle old stone age. The name of this epoch comes again from the location of its type station, Le Moustier, a small village on the Vezere, in Southern France. As previously mentioned, in the earlier epochs the skill was exerted on the central core of flint, and the flakes were a secondary matter. In this age the main attention is paid to the flake, which is more carefully finished and is fashioned with a considerable variety of forms. The nature of the locality in which these Mousterian flakes are found is also largely new.

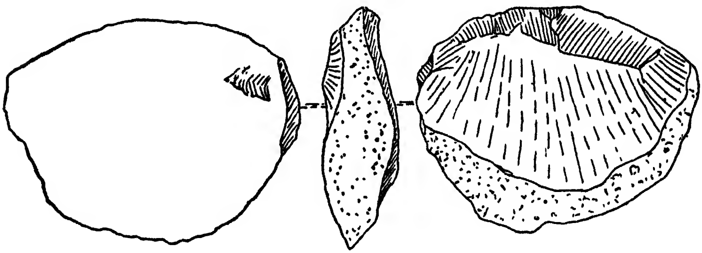


FIG. 25. MOUSTERIAN SIDE SCRAPER—AUTHOR'S SPECIMEN.

It is true the layers of gravel which yield Chellean and Acheulean hand axes also yield Mousterian flakes, but the last are found only in moderate numbers. It is in rock shelters and caves that the Mousterian remains are most abundant.

My own Mousterian specimens consist of a side and an end scraper. The side scraper, of grayish flint, whose outer natural surface is a whitish dirty color, is very definitely and skillfully flaked. One well directed blow had driven off a small flake from a rather spherical piece of flint. Another blow a little farther back had driven off a second flake which was then made into a scraper.

This later, second made curved surface, is one whole side of the scraper. New blows against the edge of this side, knocked from the outer side a series of well chosen flakes. The whole makes a very characteristic form of Mousterian implement.

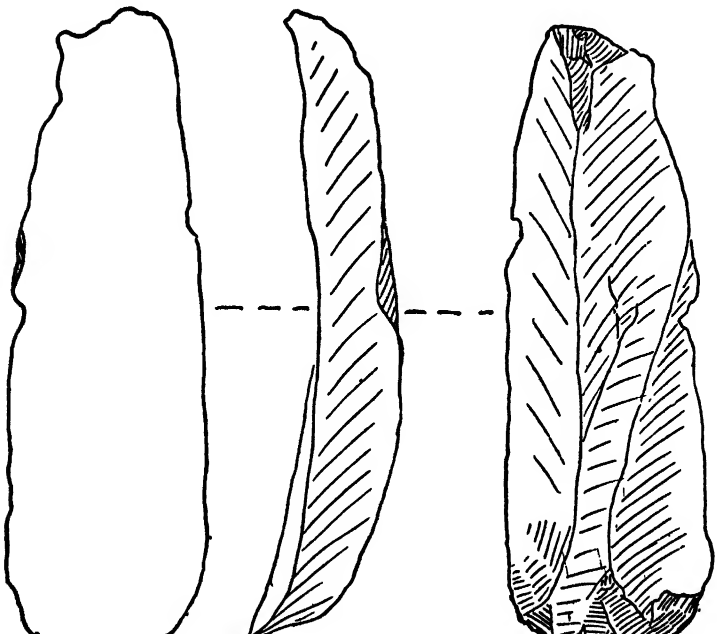


FIG. 26. MOUSTERIAN END SCRAPER—AUTHOR'S SPECIMEN.

My end scraper is the product of a still higher skill. It is made of an almost black flint. One side of it, as is characteristic of Mousterian implements, is one long flaked surface. The other side has a series of very definite flakes. It is clear that now the worker expects

a very specific result from each blow. Little is left to chance. The lower end is well sharpened by more lightly struck flakes and the whole is an effective implement for hollowing out a piece of wood, or scraping the fat and loose connective tissue from a freshly removed hide. The hand axe begins to grow infrequent in early Mousterian times and before this period is over has completely gone. It grew smaller and so remained serviceable to a more skillful age; but the varied implements made of the flakes, each served its purpose better than the old generalized hand axe. After a while there was no work left for the primitive implement and it drops out. The axe has given way to the knife.

A new material is coming into use. The abundance of scrapers in the early levels tells how commonly man must have used the straightened, sharpened stick as a weapon. This material is, however, of slight durability and no traces of it remain. The bones of the animal he slew for food were more enduring and we find in this epoch a few examples of bones shaped to man's use. The slighter of the two bones below the knee joint of the cave bear easily served his purpose. Its upper, heavier end fitted his hand. Broken near the middle, the bone made a helpful tool—as is shown by the extent to which this broken end is worn smooth by use, possibly in skinning the deer or another bear. But the bone implement is as yet little shaped and not at all ornamented.

UPPER OLD STONE AGE

Aurignacian. Near the village of Aurignac, in the upper Garonne Valley in Southern France, a rabbit hole

followed down led to the discovery of a double find. The loose material, which had slipped down from the hill above, covered the skeletons of a number of Neolithic men. These were decently reburied by the village authorities. Later digging showed that the floor of the cave was itself the reposing place of a culture far older than the skeletons that had been removed. The layer containing these older remains extended outside the cave beneath the overlying rubbish. This stratum had through it a fine collection of implements of the type since known by the name of this village as Aurignacian.

With the oncoming of the Upper Old Stone Age an entire change comes over the culture of the people of Europe. The alteration is so abrupt, there are so few transitional forms, that it is evident we have here the incursion of a people from outside who were the superiors in mental caliber and in material possessions of the Mousterians whom they replaced.

The undersized, stooping, low-browed Mousterian gave place to the tall, erect, high-browed Cro-Magnon. We will leave the account of the people and of their artistic accomplishments for a later chapter and confine ourselves here to a description of their implements.

The great characteristic of Aurignacian times is the production of excellent flint knives by the process of pressing off instead of striking off the long slender flakes. This made a tool to which the name of knife seems far more appropriate than it was to a sharp-edged Mousterian point. Not only is the Aurignacian knife long and thin, but often there is a distinct notched base that makes an evident handle. A still more characteristic addition to the human stock in trade is the graver. The new use

of bone, and the artistic impulse to decorate bones and the walls of the cave could only have evolved side by side with the development of a new tool.

My own Aurignacian knife is made of a grayish black flint. It is nearly five inches long, an inch and a quarter

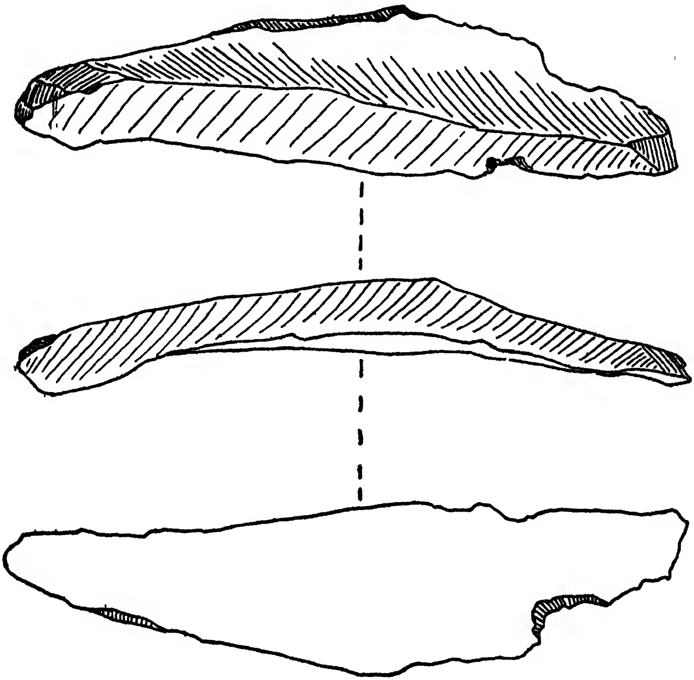


FIG. 27. AURIGNACIAN KNIFE—AUTHOR'S SPECIMEN.

wide and at its thickest place only one-quarter of an inch through. The edge is extremely keen. Either the knife was lost soon after its manufacture or the owner prized it highly and used it with the utmost care.

The implement in my own minute collection which

appeals most to my own imagination is this graver. It is made with consummate skill and entire prevision of its form. It is about three inches long and is made of a fine grained slightly translucent piece of yellowish white flint with a flush of pink. One side is a clean surface struck off at one blow from the parent core. The other side is formed by carefully directed pressure flaking.

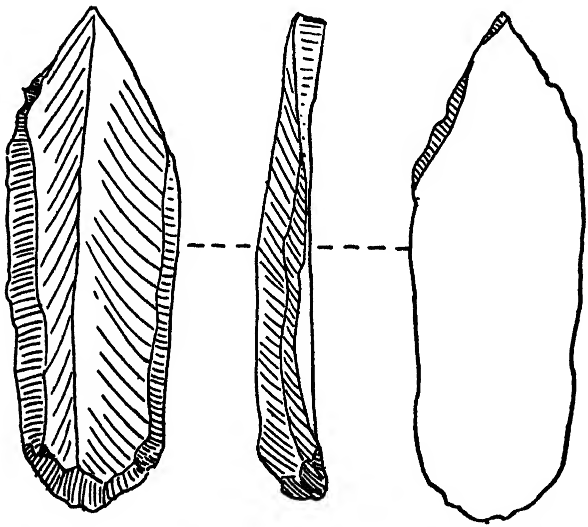


FIG. 28. AURIGNACIAN GRAVER—AUTHOR'S SPECIMEN.

The upper end is fashioned into an edge as clean and precise as a modern narrow framing chisel. This is the end which was used in cutting into the wall of the cave, the first real products of human fine art. Hand and brain have progressed together and here is the burin of the first tribe of etchers in Europe. The owner of this tool had come to give some of his attention to other things than the food he ate and the skins he wore.

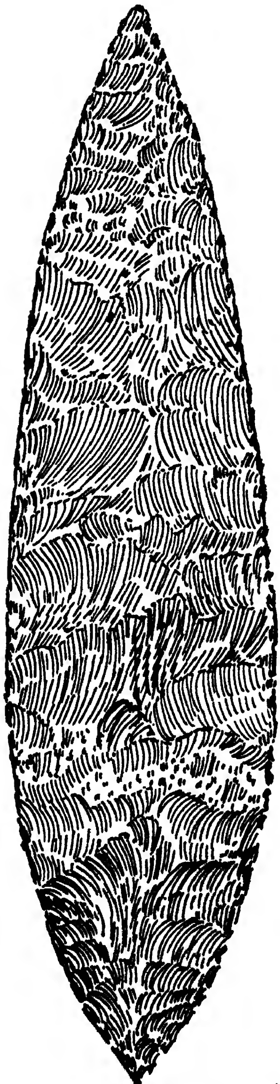


FIG. 29. SOLUTREAN LAUREL LEAF POINT, AFTER DEMORTILLET.

Javelin points now come to be made also of bone—sometimes cleft at the back to receive the end of the stick which formed the shaft.

Solutrean. On the slope of the hillside, at the base of a limestone cliff in North Central France in the commune of Solutre is a mass of rubbish, rotted and washed down the hillside, chiefly material cracked off from the cliffs farther up the slope. Enclosed in this rubbish is a host of material, which has been repeatedly uncovered, and which consists of abundant bones of animals and of human implements. The deposit proves to run through the entire range of the Upper Old Stone Age and has abundant material of all three epochs compressed in this period. The locality was one of the first, though not the very first, to yield flint, to which the name of Solutrean has been given.

In this epoch, flint flaking reached its very highest development, except in ceremonial knives of Egypt and of Scandanavia in Neolithic times, which reach an almost unimaginable perfection. The flints now take on very many forms but the typical implements are the earlier forms of the "Laurel Leaf Point," and still later the even more delicate "Willow Leaf Points."

These Laurel Leaf flints may vary in length from two or three inches up to more than a foot in length. They are wonderfully symmetrical, equally and evenly flaked on both sides, with wonderfully straight and keen edges. They are, even when ten inches long, less than half an inch in thickness.

The "Willow Leaf" points of the upper Solutrean are still more delicate in the flaking and slenderer in their

form. Many bone implements and occasional pieces of worked reindeer horn are also found at this level.

Magdalenian. This closing culture of the Old Stone Age takes its name from the station of Le Madelaine which was very close to Le Moustier in Southern France, where it is well developed. The Solutreans were wonderfully skilled in the flaking of flints. The Magdalenians were quite careless about their flints. They chiefly cared for delicate three-sided little spikes of flint, which they used in decorating the bone implements of which they first made really extensive use. As the epoch developed the bone tips of javelins and harpoons, which at first were simple, slender points, become barbed, first on one side only, later on both sides. Few of these later harpoon heads are without some ornamentation and occasionally they are elaborately artistic.

These carvings were made with the flint points above mentioned which have come to be known as microliths (little stones).

The three microliths in my own collection are from an inch and a quarter to an inch and a half in length and rarely more than a quarter of an inch wide at the heavy end. They have two smooth flaked sides and usually one that seems as if it had on it the old exterior of the core. The points are very sharp. They would have served equally for etching on bone and for boring the eyes in the bone needles which in later Magdalenian times became abundant. These bone needles are from one to three inches long and quite slender, not unlike a bodkin of the present day except that the eye is always round.

Reindeer horn and mammoth tusk ivory are abundant

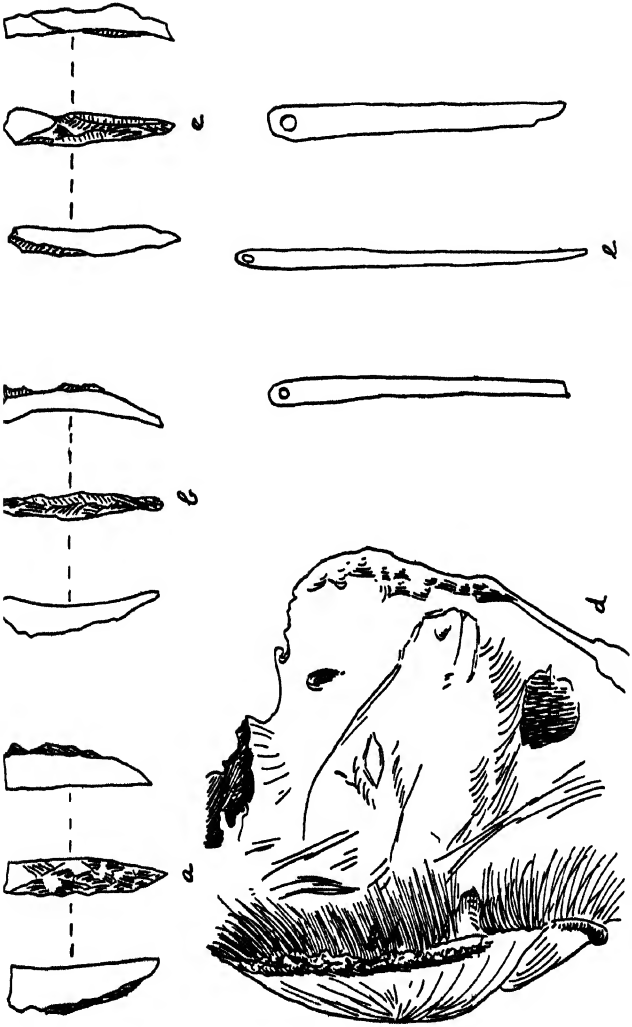


FIG. 30. MAGDALENIAN ETCHING NEEDLES (a, b, c—AUTHOR'S SPECIMEN) AND THEIR WORK (d, AFTER PIETTE), AND BONE NEEDLES (e, AFTER VIRE).

in Magdalenian deposits, the former in harpoon and spear points, the latter in forms apparently chiefly as a background for carving. The supposed purpose of these carvings will be discussed in a later chapter. The marvelous product of this upper half of the Old Stone Age was its wonderful mural art—the etchings and paintings on

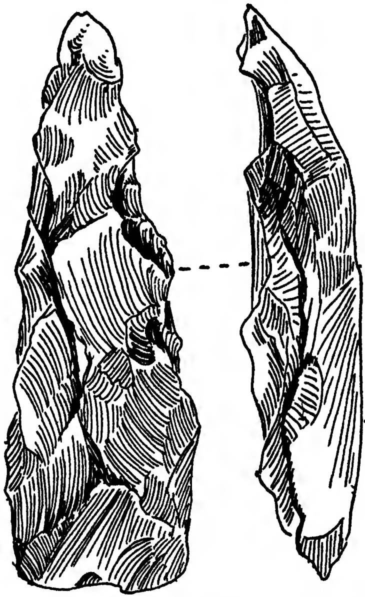


Fig. 31. Neolithic Celt, in the Rough—Author's Specimen.

the walls of the caves. These too will be reserved for later treatment.

The New Stone Age. With the close of the Old Stone Age modern man comes on the scene. The people of Europe from now on seem to show the three present types of white folks in Europe and in America. These types will be described in a later chapter. These men

bring with them new and certainly superior weapons, but they entirely lacked the art impulse of the Upper Palæolithic people. The flint implements now take an entirely new form. The axes are largely wedge shaped and are sunken in the side of the haft. What gives particular

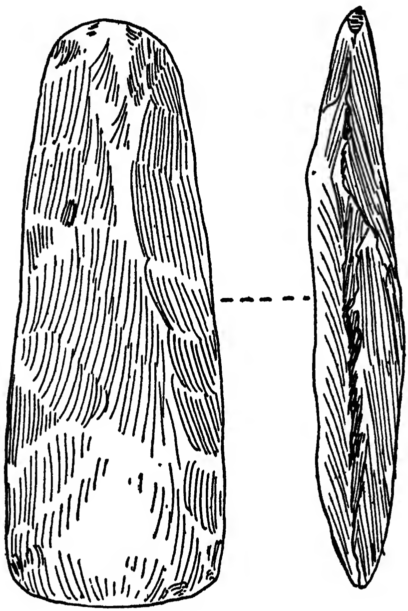


FIG. 32. NEOLITHIC CELT, FINISHED—AUTHOR'S SPECIMEN.

character to these celts, as they are called, is the fact that now often, though by no means always, at least the cutting end of the celt has been rubbed on a flat stone with sand and water, even in a few instances with emery, until it has gained a smooth surface and sometimes even a high polish.

My own collection has three Neolithic implements. The

first is made of flint that has laid buried in a chalky soil since it was made and is stained very white. It is crudely chipped and was probably lost before it was finished. It is nearly six inches long and measures one and three-quarter inches at the widest part. Its edge is only moderately sharp.

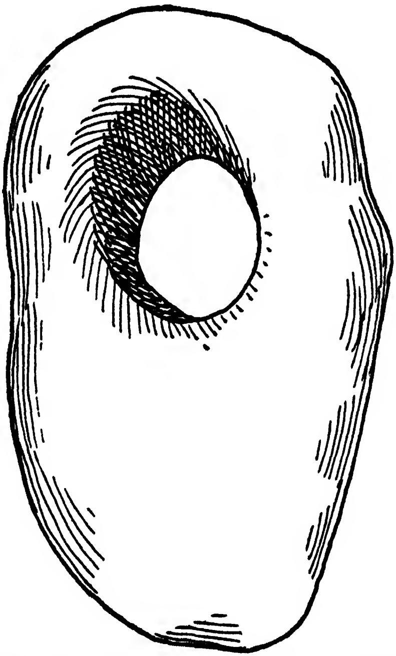


FIG. 33. NEOLITHIC PERFORATED STONE—AUTHOR'S SPECIMEN.

Another specimen is of about the same size but is far more elaborate in its finish. It is symmetrical and has no very rough edges or corners anywhere.

Its lower edge is beautifully polished and is a genuinely effective cutting line.

The third specimen may be a hammer, it may be a sinker on a net. It was found on an island in the upper Rhine. The hole probably was bored with the end of a piece of bone or of wood, using this to apply water and sand. This specimen is quite waterworn.

In this period we first find pottery, which is in the beginning quite crude. After a while bronze takes the place of stone. This proves to be so workable that improvement is rapid. After a while iron, so much harder to win from its ores than is bronze, begins to replace the latter alloy, and we are down to historic times.

CHAPTER VI

Low-Brow Stone-Age Man

The Gibraltar skull. The first well-known man, Neanderthal. The form of his head and body. Attempts to restore him. His African cousin of Rhodesia. A season in the life of Neanderthal man.

I

We have been dividing the time of the Old Stone Age into two great periods. The earlier of these comprising the Chellean, the Acheulean, and the Mousterian, runs through a period of seventy-five thousand years. For the first fifty thousand of these years the climate was more or less mild. It was an interglacial time. During these years man needed comparatively little shelter. Like the beasts of the field he roamed from place to place, never making for himself enough of a habitation to leave any trace behind him. The fact that he had no pottery in which to carry water made it necessary that he live near a stream, consequently almost all the implements of these epochs are found in the debris along the banks of the rivers of Western Europe. The glacial periods had left a series of terraces along many of the streams. On the edges of these terraces were piles of stones transported by the stream or fallen from the cliffs above. It is in

these collections of talus and the beds of transported gravel that the crude hand axes of the Chellean time and the far more beautiful axes of the Acheulian epoch are almost entirely found. With the oncoming of the

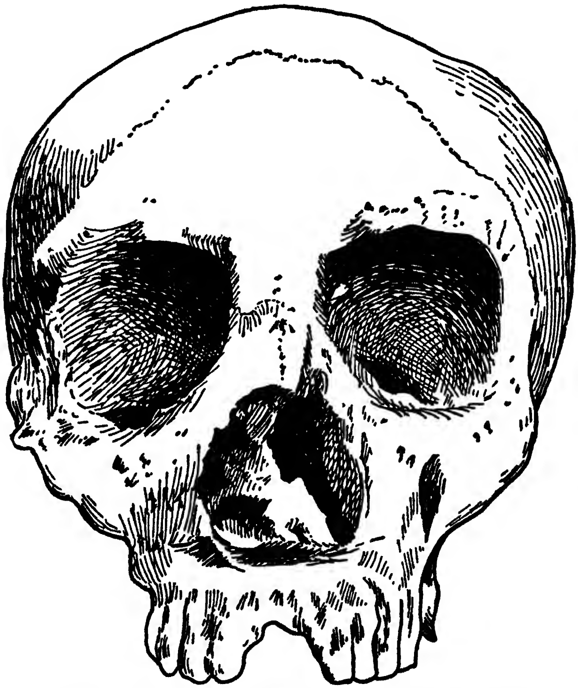


FIG. 34. THE GIBRALTAR SKULL, AFTER HRDLICKA.

last great cold era, the fourth glacial, came Mousterian man. It is still quite a problem whether the sort of man we find abundantly in this Mousterian epoch was there through the Chellean and Aurignacian time also, or was an alteration, some say a degeneration, of the earlier men. Still other authorities think he came in from the

outside. There is good evidence for each of these possibilities and no certainty about any of them. Mousterian man we know very well indeed. Of any human being earlier than this we have only a few fragmentary bones, or even in one case a lower jaw. Now we have abundant material. There are forty or fifty examples of Mousterian man, consisting in some cases practically of entire skeletons. So we know this man in every part of his framework.

A skull, or the main part of a skull, had been found in Gibraltar in 1848. It eventually found its way into the collection of the Royal College of Surgeons in London. But it somehow attracted very little attention for a considerable time, though this has been amply atoned for since. All are now agreed that in general character this skull is built like that of Mousterian man. It shows, however, a very small cranial capacity, whereas the typical Mousterian man, the Neanderthal, has an unusually large skull. It is now thought by many anatomists that the Gibraltar skull is that of a woman and is an early and not yet highly developed type of its kind.

The great find which set the anthropological world battling is the "Neanderthal" specimen. This Neanderthal is a gorge in the limestone, at the bottom of which runs the Düssel River, a small stream emptying into the Rhine from its eastern side, a little below Coblenz.

In a cave in the side of this gorge a great mass of earth was found covering the floor. When this was removed, in 1857, many fragments of a skeleton seem to have been turned up. Probably the entire skeleton had been there originally, but the workmen had no sense of the value of their find and finally, when its importance was

realized most of the broken bones had disappeared, leaving only a skull cap and a number of the limb bones which were enough to give a very fair idea of the character of the Neanderthal man. Lyell early interested himself in the specimen and Huxley described it in his famous "The Place of Man in Nature." He believed it too low to be really called a man and thought it should be put into a new genus. Now anthropologists are agreed that it is man, and that it is not Homo sapiens—present man. This

FIG. 35. NEANDERTHAL SKULL CAP, AFTER HRDLICKA.

man of the Mousterian Epoch is variously known as Homo primigenius, Homo Mousteriensis, and Homo Neanderthalensis. In the literature of the subject in English, however, he is now generally known as Neanderthal man. In the district of Spy in Belgium there is a limestone cave with a mound of debris in front of it, overlooking the Orneau. In 1885 two archæologists, realizing this to be just the sort of location early man was likely to choose for his habitation, began clearing the debris from the floor of the cave.

Between nine and twelve feet beneath the surface of

the floor was a quantity of Mousterian flints, of ivory points, and of the bones of the woolly rhinoceros, mammoth, cave bear, and Irish elk. Beneath these, and evidently the result of intentional burial, the searchers un-

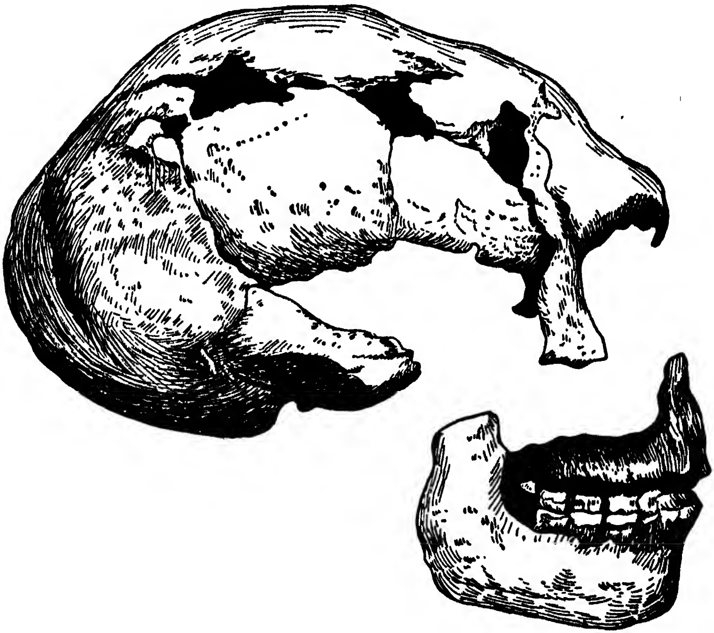


FIG. 36. SKULL OF SPY 1, AFTER FRAIPONT.

covered two full skeletons of human beings of the Neanderthal type. These are known in the literature as Spy I and Spy II.

New material on this subject was added when in the years immediately succeeding 1900 a marvelous find was made at Krapina in Austria-Hungary. Here again the remains were found in an earth-filled cave, or indeed rock shelter, too shallow to be called a cave. Here, mixed

with the bones of the cave bear, and with ashes of old fires, in hopeless confusion, were about three hundred human bones, belonging to certainly no less than ten in-

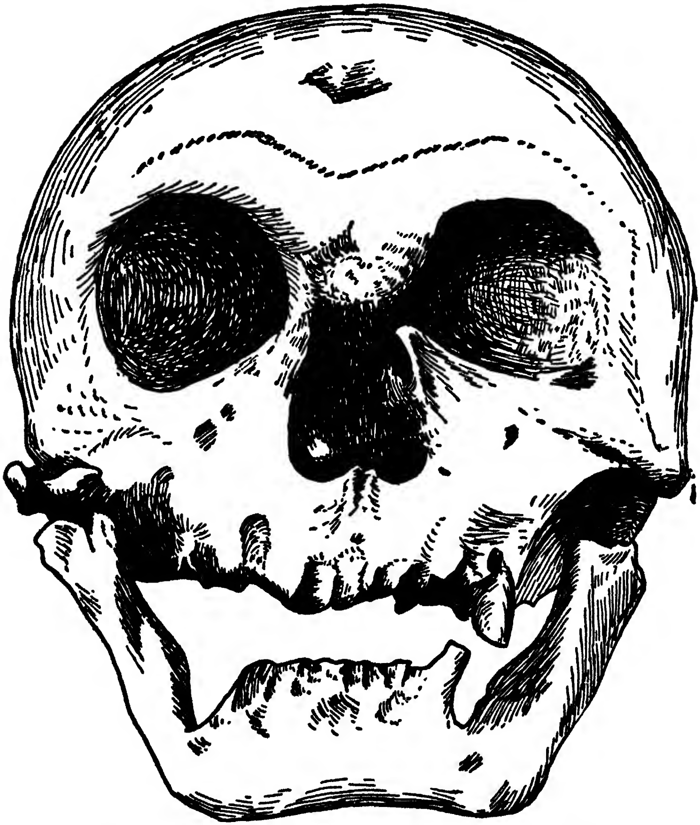


FIG. 37. SKULL OF CHAPELLE-AUX-SAINTS, AFTER BOULE.

dividuals and quite possibly to more. To add to the value of the find we have here men, women, and children. So many of the long bones are broken as to have fur-

nished ground for the speculation that these fragments are the result of a series of cannibalistic feasts. It may be. If so, it is the only example of any indication in this direction found concerning primitive man. It has been pointed out that when man cracked the limb bones of the animals he used for food, to get out the marrow from the bones, a practice common with him, he split these bones lengthwise. The fractured long bones of Krapina are broken across.

In 1908 at Chapelle aux Saints in the Dordogne region of Central France was found a particularly fine skeleton, the finest of all the Neanderthal specimens. The face of this find is almost perfect, the skull is undistorted and its size is hence without conjecture. The French anthropologist, M. Boule, gave a remarkable description of this skeleton.

Later the same general district yielded many other specimens more or less complete. The material is now abundant, and many capable students have undertaken to build up for us not only a picture of Neanderthal man himself, his head, his limbs, his trunk, his posture, but also his manner of life, down even to some of his habits. Part of this is of course conjecture and yet it is marvelous that it should be possible to visualize so clearly, from positive indications, so much about a sort of man who perished from the earth, at least in very large part, not less than twenty-five thousand years ago.

II

It is clear that we have abundant material at our hand to tell almost all we care to know about the framework

—the bony skeleton—of the Neanderthal type of man. In stature there was naturally considerable variation in the different skeletons, but none seems to have been over five feet, five inches, and the men varied from that to little more than five feet. The only certainly female skeleton (La Ferrassie II) seems to have stood about four feet, ten inches, in height.

The skull in any of the individuals of mature years is large, unexpectedly large. So far as cubical content is concerned it is quite as big as the average man of to-day. The Gibraltar skull is small, but is in all probability that of a woman. The Le Moustier skull is somewhat small, but is that of an adolescent boy. The original Neanderthal skull, the two of Spy, the Krapina and the Le Chappelle aux Saints are all very much alike in character and in size. The size as we said is modern, but the shape is very far from that of man of to-day.

The most striking character is the ridge over the eyes. The upper border of the eye sockets is much swollen, forming a high ridge which must have given the face a particularly frowning and hence forbidding look to us who are accustomed to its absence. To those who knew no other human form of face it must of course have seemed quite natural. Experience, our real teacher in such matters, had lead them to associate that appearance with the natural disposition of man of the time, which to them of course seemed very good.

Back of this bulging eye-roof came a forehead that to us would seem to slope very sharply back and to be very low. In this respect it is quite ape like—though not as markedly so as in the Java half-man, and more than in Piltdown man.

The jaw is heavy and so are the teeth. The teeth are quite different in character from those of modern man. There is a larger opening in the root end. This is the pathway by which blood vessels and nerves pass to the inside pulp of the tooth. This sort of structure, in lower mammals, is associated with teeth whose growth is con-

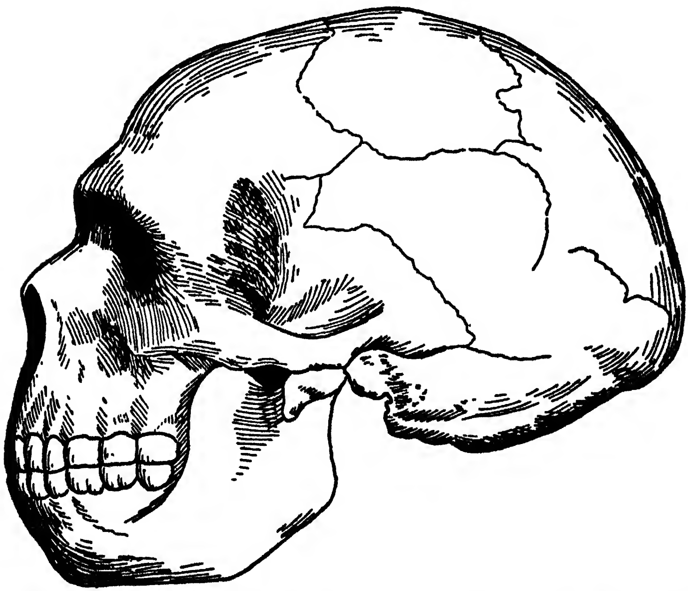


Fig. 38. Restored Skull of Neanderthal Man, after McGregor.

tinuous. If we lose a tooth, the tooth opposite it, no longer opposed or worn by its antagonist, slowly pushes farther out of the gum. This must have happened to much greater extent in Neanderthal man than it does in us. He wore his teeth hard, but they responded better than ours to the heavy friction. Even so, the owner of Spy skull number I had lost his molar teeth, even though

the joints where the bones of the skull met each other indicate that he had not yet reached any extreme age.

The front teeth of this man sloped forward instead of upward as do ours. This gave him a protruding mouth, which was further emphasized by his entire lack of a point to the chin. While the chin did not recede nearly as much as in Piltdown or even as much as in Heidelberg man there was an entire absence of what we consider a strong chin. And yet I can scarcely imagine the effect to have been what we to-day call a "weak chin." The whole strength of the jaw and of the teeth belie that. Just below the inner bases of the incisor teeth there are in man of to-day a series of short sharp projections of needle-like bone. These give attachment to the many small muscles of the tongue which give to that member its extreme flexibility. It is interesting that these projections are only slightly rounded eminences in the apes. In Neanderthal man the indications are that these projections are not so long or delicate as in modern man, nor so short and blunt as in the apes. In other words Neanderthal had the organ for speech in moderate development, though by no means to the extent which would have made possible a modern language. Meaningful sounds in reasonable sequence he doubtless could produce.

Still another peculiarity of the Neanderthal skull is evident on close attention. The hole in the floor of the skull by which the spinal cord enters the brain cavity is set farther back than it is in modern man. At the same time the line showing the upper border of the muscles of the neck, marking the limit of their attachment to the back of the skull, is very high. In other words the neck sloped more to the front and was less erect than in our

case. The mouth was thrust forward, the jaw being lifted off the chest far more than is ours.

The backbone is heavy and short. Its greatest peculiarity is that it made only one curve from the hips to the skull. With us there is a hollow in the small of the back, a protrusion over the shoulders and a hollow in the neck. This makes of the backbone an S-shaped spring that can absorb the shock of a jump and prevent jar to the brain within the skull which, in us, is perched over the backbone. Neanderthal man broke the shock by letting his head fall forward.

The arms were unusually short for the height of the man, shorter in proportion than the legs. The forearm was proportionately shorter than the upper arms. The hands were large and the thumb not so movable as ours. He could not make his thumb touch the tips of the other fingers nearly so easily as we do. Perhaps he held small things more as the chimpanzee to-day is apt to do, between the top of the thumb and the joint next beyond the knuckle of the first finger.

The bones of the leg were very heavy, with large heads and short shafts. The shin bone was very short proportionately to the thigh. The smooth ends of shin and thigh which met at the knee show plainly that the leg could never be held straight at the knee. The knee always protruded forwards. In addition, the facets of the ankle joint show an unusual position there. This position is found to-day in some of the savage tribes who squat on their heels instead of sitting as we do.

It is the fashion nowadays to see in the secretions of the endocrine glands the solution of most of our physiological problems. These glands take from the blood

materials which they make over into their characteristic substance and pour this back into the blood. This substance is a "chemical messenger," (hormone), and, passing through the blood vessels, stimulates other parts of the body to do certain things or to develop in certain ways. Dr. Keith, the English Anthropologist, thinks Neanderthal man a hormone product, perhaps monstrosity, deviating considerably from the general line of man's descent. He says "the peculiar character of the Neanderthal type appears to be under the particular domination of the small pituitary gland at the base of the brain; when this gland becomes enlarged, as it occasionally does in the disease called acromegaly, the Neanderthal characters are developed in the subjects of the disease in an exaggerated and bizarre form. The functions of the pituitary seem to afford a key to Neanderthal characteristics."

Whatever of surmise there may have been in the restoration of any of the preceding human or half human forms, now we are on solid ground. The materials for this restoration are abundant. Dr. McGreggor has modeled well the head of Neanderthal man. The projecting eye ridge, the sloping forehead, the thin back of the head, the projecting teeth, the pointless chin, the sloping neck, all stand out here plainly. He has also given him an expression of face far from brutal, and yet by no means the face of a civilized man of to-day. (Frontispiece, B.)

III

We should at this point glance at a skull found far from the European caves and yet distinctly of the same character as those just mentioned.

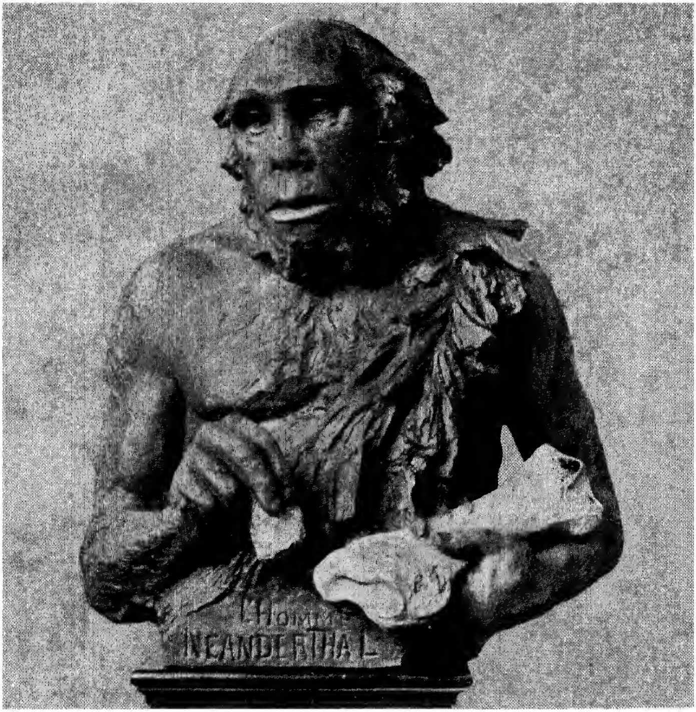


PLATE III. NEANDERTHAL MAN, AS RESTORED BY M. MASCRE UNDER GUIDANCE OF PROFESSOR RUTOT.

Taken from *Prehistoric Man and His Story*, by F. Scott Elliott.

In the northern part of the province of Rhodesia in South Africa, is a hillock known as Broken Hill. This kopje is mined for zinc, lead and vanadium. A cave runs nearly through it. On the floor of this cavern was a great pile of animal bones. These were so crusted with silicate of zinc, crystallized out of drippings of water from the roof of the cave, that they had been mined for

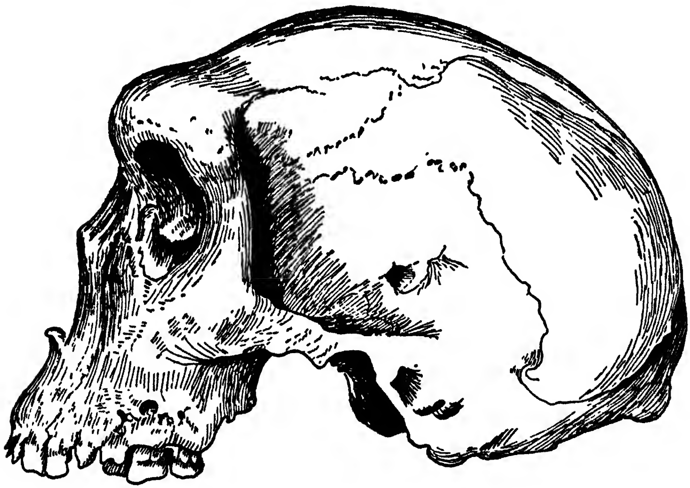


FIG. 39. SKULL OF RHODESIAN MAN, AFTER HAUSER.

zinc with the rest of the ores. After this pile was pretty well removed it was found in 1921 that farther back in the cave was an entire skull of a man, lacking the jaw. There were also other human bones or fragments of bones with such duplications as make it seem likely there were originally two skeletons.

This skull is now in the South Kensington Museum, where it is securing such attention as will later deter-

mine its exact position in the human scale. A few things about it seem clear.

It is human beyond question, and should be placed in the genus Homo. The skull is low and long. The eye ridges are the heaviest yet encountered in man. There is no line dividing the cheek from the side of the nose. This would indicate a very ape-like face. The nose is wider than that of any Negro of to-day. The length between the base of the nose and the root of the front teeth is very long and very prominent.

The lower jaw must have been very large. It was certainly as large as the Heidelberg jaw and possibly larger. The brain cavity is of good size; much larger than that of the Java half-man and not as big as that of Neanderthal man of Europe, to whom it is evidently more closely allied than to any other human skeleton with which we are acquainted.

The age of this specimen has thus far defied determination. It was on the floor of the cave. It was covered with the zinc deposit like the bones of the pile. But the bones of the pile, so far as yet determined, all have representatives in Africa to-day. There is nothing to prove whether the human and the animal bones are of the same age or of different ages. Unfortunately there is a large hole in the roof of the cave, and any, or all, of these creatures may have fallen in within comparatively modern times.

Two interpretations have been put on Rhodesian man. What is perhaps the more common is that he is an offshoot which early wandered away from the Neanderthal line, and in the comparative isolation of South Africa, long free from any competition with higher types of men,

evolved slowly and remains to show us a near parallel to a stage in the earlier evolution of Neanderthal man.

The other opinion is that he is the direct ancestor of Neanderthal man and that the latter came into Europe from Africa. The latter half of the conclusion is probably concurred in by most anthropologists. In history, and probably for a long time before history, North Africa has belonged to Europe far more than to South Africa. Neanderthal man doubtless moved up and down across the bridges which spanned the Mediterranean at Gibraltar and at Sicily, in repeated migrations, depending on the approach and recession of the glaciers. The Nile passage way is clearly an old one, and was once fertile over a wider strip than the present valley. But doubtless these barriers were effectual, and it is generally believed the parts now lying above and those below the Sahara have each developed largely without very much effect from the other and with such meager communication as there was coming only at wide intervals of time.

The whole question is still an open one. Africa is one of a half-dozen places suggested as the home of the race. Central Asia, Southern Africa, a southern land between India and Madagascar, called by the geologist Lemuria, even England and Scandinavia, have been proposed by men who base the suggestion on evidences in the shape of human remains, and their accompanying implements and animals.

As mentioned before, American anthropologists as a group lean to Central Asia and are backing their ideas by expeditions sent into the neighborhood; which thus far have found no direct evidence bearing on the question.

IV

It is late afternoon of a day in spring of the year 30,000 B. C. in the valley of the Dordogne in Central France. The river here makes a great bend, and carves the outside of the curve out of a birch and aspen covered hillside, which faces the south and catches the warm sun through much of the day. All snow is gone from the genial slope, although patches still lie over much of the rest of the landscape.

Inside the curve of the stream lies a long, flat, gravel-covered stretch of ground, laid down by the stream in its flood times. Low willows cover it in patches and tough sedges here and there bind it into power to resist the wash of the stream when the water is high.

At the base of the hillside a rivulet pours its chilly waters into the stream, after a leaping course down the steep slope. A footpath winds its way up the hill, following closely the stream and seems to end in a thicket of poplars. Back of the thicket is a trampled stretch of bare ground littered with the debris of a careless living group of strange looking people. Fires have been builded here and there and the dead coals spot the ground. Old bones, charred and cracked, are lying about. Broken weapons, discarded, now that they are useless, are scattered abundantly.

Just back of the bare ground is the mouth of a cavern. Out of it comes a slow current of air that in contrast with the colder atmosphere outside seems warm. Strange to the minds of the men about, when the weather outside is warm, the air from the cave comes out cool; which is only one of several strange things about the cave. The

hollow runs back farther than any of them have ever dared to follow it. Over to the left, as one faces the cave, and higher, is a hollow, almost separated from the rest. Here an old man sits squatting on his heels. He is feeble with age, but holds himself aloof from the rest, who bring him food, which they lay before him and which he leaves untouched until they have rejoined the group below.

Prominent amongst the others stands one man, short, heavy set, with a terrifically frowning forehead, heavy arms, well covered with hair. His head, thrust far forward, seems to be forever on the lookout. His heavy chest is also covered with hair, as are his clumsy, bent legs. About his body is thrown a bear skin, whose overlapping ends are pinned together with a piece of twig. He seems quite as comfortable with or without it, at this season, as do all the rest of the strange group, none of whom are more fully clad than he. All the younger members are entirely without any covering unless their own rather abundant hair could be so denominated.

The big man is clearly the head of the group. Others walk out of his way when they pass him. When they pass each other, they jostle each other, as much in sport as to assert the right of way.

A woman has charge of a fire near the mouth of the cave on which bones and joints are roasting. She lifts a smoking bone from the coals, cracks it with a blow from a heavy stone, and offers the open end to the man. He inserts his finger in the hollow of the bone and brings it out covered with the marrow which he sucks from his finger. It is evidently to his taste, for he walks over and squats by the fire. Only then the four others of the

group, two young men, one still quite a boy, and two girls, gather around the same fire.

In another side of the cave, by no means so comfortable, another group gathers about its fire. The groups are clearly friendly, but it is quite evident that one ranks above the other.

There seems no lack of meat to eat, and there is not much of anything else. Other things are casually eaten through the day as they are found; birds' eggs or young birds, larvae of beetles, grasshoppers and big ants all seem to serve as the accidental food, but the meal is meat.

There is comparatively little sound made by these people. Gestures are abundant and seem to serve all ordinary purposes. They seem to watch each other closely to catch these gestures, grunts of approval mark the finding of a particularly tasty piece of marrow.

One of the boys slips down the pathway to the rill for a drink. He comes back quickly shrieking. The chief—his father—grasps him by the arm; stifles his cries with his hand and looks questioningly into his face. "Growler," says the boy—and his father understands. Years before, when they had first come up the valley, the tribe had smoked out a family of cave bears from the cave. Most of them they had succeeded in killing with clubs and stones as they lay half smothered by the smoke, but two of them had escaped, and every now and then tried to make their way back into the cave.

The "Chief" walked to the edge of the platform and peered through the gathering dusk into the thicket. A gleam of shiny eyes told him the bear was still there. He picked up a brand from the fire and hurled it at the

beast, whose slow lumbering tread told of his only partial retreat.

The man turned back to his fire, which the woman was by now covering with ashes, and placed a half green bough with its end under the coals. The young folks had each rolled up in a bearskin, and all of them were soon sleeping the sleep of those with a full stomach and no troubles of conscience.

The group by the other fire were also asleep. The old man in the detached corner never seemed very wide-awake and they never found him tight asleep.

The chief squatted himself near the head of the pathway, his gaze turned in the direction in which the bear had disappeared. Twice he heard the heavy footfall through the bushes. Once he saw the gleam of the eyes. Then he pulled out the brand from the fire, and waved it across the path. Each time the bear backed abruptly into the bushes.

After a long watch, Chief rose from his heels, and walking to the second fire pushed the man of that group with his foot, and motioned to the head of the path. The other wakened promptly, and was alert in an instant. Without a word he took the place of Chief who curled upon his bearskin beside his mate who was wrapped in a reindeer skin. She nestled closer to him and gave a grunt of comfort and was off again in no time.

The next morning all the tribe was awake with early dawn. This was to be the day to start the first great hunt of the season. The cave would be likely to see the men only by ones or twos, until fall, when all would come back to spend the cold winter once more in the shelter.

Two of them were missing. The older boy from the

second fire and one of the girls from the first. The chief grunted an inquiry to his mate and she motioned with her head down the path. He understood; and when the two came up the path a little later, wrapped in one bear skin, and stood erect before him, he led them to the old man in the corner. He held out his hands to the sky, put the boy's arm over the girl's shoulder and they walked over and seated themselves by the first fire. The woman lifted a morsel of meat from the fire and handed it to the man. He took a bite and handed it to the woman, and a new family had been adopted into the tribe.

Much had to be done to get ready for the hunt. First they rolled big stones before the mouth of the cave, leaving a small opening only. The women and children and the old man were accustomed to sleep in the open space before the cave unless the weather was very bad. A wetting was a small matter in their lives. The cave was damp in spring too, and the shingle before the cave much drier. But the cave was there for refuge, so they made the opening so small that the women and children could with firebrands keep out the bear if he came.

The chief called the young girls and led them to the fire. He set them in a circle about it and they knew that it was entrusted into their hands, and must not be allowed to go out before his return.

He called the boys together and they stood before him. Each laid his little collection of short spears on the ground in front of the Chief. He looked them over, broke a few of the poorest, and nodded them away. It was their duty to keep the women in lemmings and ptarmigan (like our

woodchuck and grouse). Then he stood the boy beside his mother to show him his duty.

Lastly he summoned the old man, who came with flowing hair and stately step down the cave. All the men who were going to the chase stood before him with their weapons on the ground. He waved his hands high in the air, then beckoned towards all corners of the horizon, to summon the game. Then he laid his hand on each man's right shoulder and passed it down his arm to give him strength, then passed his hands over the weapons to make them do their duty, and marched back into the cave, proud that his day had once more come.

Off the men went to the chase, Chief in the lead with his short heavy flint-headed spear in his hands. Back of him followed his son, then the man of the other group—his cousin—and his son. Down the steep pathway they plodded in a stolid march. Reaching the river they waded in as if paying no attention to it. When it got too deep for wading they swam with a strange up and down movement of the hands, much as a dog swims. They had not gotten far beyond the other bank when they were joined by another group from a different cave and after a time by still another. The band now numbered about a dozen and together they plunged into the forest. Under its protecting shadow they scattered, each returning once more to the edge of the woods overlooking the grass-grown neck, which was only the widened stretch of a similar area running for miles along the south bank of the river. As each one reached his place he squatted and stolidly kept his eye on the open country. For the first day nothing of moment happened. The next day a wild bull with heavy horns whose bases

almost met on the forehead, and whose tips were a yard apart, wandered along the meadow. With him were two cows. The whole line of men now became alert. At a call from Chief all rushed out from cover, trying to cut off the retreat of the cattle. The bull gave a furious bellow, and charged terrifically at one of the men, whose awkward legs and slow feet could not carry him out of the way fast enough. The bull lifted him on his horns, threw him a distance ahead, gored him with one turned horn, and rushed on followed by one of the cows. Their way was clear, and they escaped. The remaining cow, frantic with fear, had started in the other direction along the bank. Surrounded as she was on all sides by men who were jabbing at her with their short spears, beating her with clubs and hurling stones at her, she soon sank to her knees, then rolled over. The men with clubs and stones pounded the life out of her. Most of them had had nothing much to eat for two days, since they had been compelled to sit quietly on the watch. A few grass-hoppers, some big ants that came their way, they had eaten. Some of them had found birds' nests in the bushes and eaten the eggs or the young birds. Small food this for hungry hunters. Their flint knives now ripped the hide from the animal and cut the big muscles from the flesh, and severed the big joints.

Chief sent his boy back across the river with a big piece of meat and with the command "Fire."

In a few hours the boy was back with glowing coals wrapped in sod and a fire was soon roaring. Many of the men had already eaten of the raw flesh, but now all gathered around the fire with pieces of meat on pointed green sticks, and roasted the meat over the fire. Then

they moved on a distance leaving the carcass with its entrails and its tougher parts to the wolves. The dead man's body was thrown into the river. He had been a courageous man and they did not want the wolves to eat him or it would have made them more courageous to attack the camp at night. Then they curled up and went to sleep. Every man was gorged and for the next few days none of them moved about much. On the fourth day Chief started trudging on down stream and the line followed until at a sign they went back into the woods and repeated their tactics of the first day. So the summer went on. As long as they were near enough, they sent meat back to the cave and brought fire. When they got too far away Chief took an old piece of dry wood; with his flint knife he scored a groove in it, and laid it full of the little pieces of wood that were detached. Then he took from his belt a hard piece of wood with a point on it. He ran it up and down the groove hard and fast. After a long while a thin line of smoke began to come and he breathed on it gently. The tinder glowed. Then he covered it with dry grass and swung it, at first slowly, then faster until it burst into flame. The fire was then made by the rest of the group.

One day a herd of horses, scrubby little things with arched foreheads and short erect manes and no fore-locks, came along the meadow. These were soon surrounded and attacked. They could not harm their pursuers as could the wild oxen, but they were so fleet that their slow attackers could hardly hem them in. When they did, there was a great feast; for this was their choicest meat.

So the summer went on. As it drew to a close they

began to head for home working slowly up the river again. As they got nearer they began to keep the hides of the best of their animals. They began to send meat ahead. One day they surrounded a herd of wild cattle and the bull, charging, gored Chief, and that night he died.

The others stood stolidly about him for a time. Then they took his body, wrapped it in his bearskin, put with him his weapons and a big piece of meat, and back home they went.

The body was carried up to the cave and laid before the old man. He directed the digging of a pit back in his section of the cave. He laid the body on its side, drew the knees up until they nearly touched his chin, put his hands about his knees and tied them with a strip of hide. There Chief lay huddled. So he had lain in his mother's body before he came into this life; so he must lie to be born again into the next life—the life of the Chief who lives forever. Besides, trussed so, he would not wander at night and disturb the others. He must not come back to reproach them. They laid about him in a circle his best weapons and the food for his journey. Then, so the wolves and bears should not be attracted, and that the cave should not be fouled, they covered him with earth and went their way.

When they got back to the hunt there was no leader. One and another tried to lead and few followed. That night a bear came tumbling into camp and most of them started to run away. The son of old Chief grasped his spear and backed against the trunk of a tree. The bear came rushing, and the man put the base of the spear shaft against the tree, with the flint point out towards the bear. The creature came on full tilt, and was impaled on the

spear. The wound was deadly and the bear fell over, but not before the man had been gashed with the long claws. But a wash in the river and a dressing of chewed leaves was all the attention this needed from a strong man and soon all was well. But now there was no question who was Chief. The others followed his lead. He had proved his fitness.

Occasionally now the morning or the evening would bring a little snow. This grew more and more frequent —and then one day a herd of a dozen reindeer, that always came with winter, stole along the meadow. There was a great slaughter of these and, laden with the best pieces of meat, and with the skins, the group separated, each to go to its own cave.

With the oncoming of winter, there was less game. Lemmings and ptarmigan came to make up more and more of the food and the members of the tribe grew leaner and hungrier. One day the little boy came rushing up to his brother, the new chief. "Look! Nose-Horn," and he pointed across the river. There, sure enough, a rhinoceros was plodding along the water's edge, his shaggy hair hanging with sleet, his long front horn and shorter second dirty with the soil he had torn in search for succulent roots. He was too big for these people, his hide was too heavy to be pierced with their spears, his horn too terrible. Several times they saw him, and quickly noticed that he came out of the woods by the same opening and went down to a point in the stream where the water was too swift to freeze. He always came in the early morning. So one day Chief called the group and they crossed the frozen river. They dug a deep pit. They covered it with sticks and earth and dry

leaves and went back to their caves. The next morning Nose-Horn came to the edge of the wood, looked cautiously about, and turned back. Clearly something was wrong. That night snow fell, and in the cave hope rose high. The creature's woolly bulk was seen early the next morning breaking out of the woods. Along the old track he came, his heavy feet leaving deep tracks, his hair drawing marks on the snow on either side. Suddenly he plunged with a roar into the pit. From all sides the group gathered at once. All had been on the watch; all had seen. They came to the edge of the pit and peered over. There was the savage brute unharmed and terrible. Their spears could do little against such hide. They pounded his head with clubs but this seemed only to enrage him. This lasted for two days, and the creature began to weaken. Then Chief drew near and the others stood aside. Right across the middle of a hide he cut a narrow strip, a little wider in the middle than either end. He drew the narrow ends together and in the wider middle he put a cobble stone half as big as his head. He swung the stone in a circle about his head, his body swaying with his weight. Faster and faster went the stone, nearer and nearer came the man. The rhinoceros glared and reared to meet him and met the whirling stone fairly above his eye. With a terrible roar he sank back and glared. The others prodded him with poles and again he reared up against the side of the pit trying to get at his enemies. Again Chief approached with his whirling stone and this blow did the work. Now there was meat abundant for all the groups and in this weather it would last a long time. Chief took what he wanted for his cave, and the rest made way with the

balance, again leaving to the wolves, that always hung about the edge of the group, the remnants of the carcass.

Perhaps much of this is imaginary. Much of it is certainly indicated by what we find—and a little more is added by interpretation gained from our knowledge of more modern, backward peoples.

CHAPTER VII

HIGH-BROW STONE-AGE MAN

Is Cro-Magnon man a mutation? Skeletons of Cro-Magnon type. The cave art of this period. The story of a stone-age revolution.

I

When Charles Darwin became convinced of the fact of evolution, and persuaded his contemporary scientists of the truth of his conviction, he also gave an explanation of the method by which this process might have been brought about. In that explanation he suggested that any change towards the formation of a new species of animal or plant was, in any single generation, so exceedingly small as to escape notice. It was only by the summing up, through many generations, of these minute changes, continuing in the same direction, that a real change in species could have been accomplished. Darwin conceded that there were occasional rapid changes, known to the breeder and the horticulturist as "sports," but he thought these to have had little to do with origin of the great majority of species.

Near the close of the last century Hugo de Vries, of Amsterdam, suggested that the alteration might be more rapid than Mr. Darwin had suspected, indeed might occur

in a single generation. De Vries is a botanist and he had weeded out a patch of evening primroses (Oenothera) in the botanical garden, and the discarded plants were thrown on a dump outside the garden. Many of these took root again on the dump. Later, going amongst them, he was surprised to find several varieties, differing at least enough from each other to attract the eye of the accomplished botanist. He took these plants back into the garden and found that they bred true. That is, plants descended from them retained their peculiarities. This led to a close study of this plant and De Vries found quite a number of such new varieties appeared; each keeping true to its own characters in succeeding generations. To such changes, in a single generation, as were permanent, De Vries gave the name of mutations.

The idea that evolution is at least in part and perhaps largely by mutations seemed probable to a good many scientists, and occasional examples, chiefly in the plant world, have been adduced in favor of the hypothesis. If such mutations occur they shorten the possible time of the evolution of species, which in Darwin's explanation required an interminably long period.

Our ideas of the length of time concerned in the history of the earth are lengthening so greatly, especially since the students of radium have been contributing to the subject, that time seems no object and mutations not so necessary a relief. Still many biologists believe mutation plays a considerable part in evolution.

There is a supposition, perhaps only a predisposition to believe, some such process has been concerned in the development of man at the end of the Mousterian epoch.

Certain it is that the skeletons we next find, those of

Cro-Magnon man, show him to be a marvelous advance over Neanderthal man. Tall, erect, with high forehead and with a capacious skull cavity, which would hold a brain of both size and proportions like our own, this newcomer, if newcomer he be, is certainly a marvelous advance.

Is he a mutation from Neanderthal man? Is he a branch of the human line that advanced elsewhere more rapidly than Neanderthal did in Europe? Or, accounting in still more drastic fashion, did Neanderthal man slide down the scale in Western Europe while his rival cousin was at the same time going up, perhaps in West Central Asia?

Physically Cro-Magnon man is the entire equal of man of to-day. In cubic contents, his brain was quite up to ours. In accomplishment, considering what he had to start with, it is not impossible he may claim equality with us. He is of our kind. Homo sapiens is now here, and has lasted for the perhaps twenty-five thousand years reaching from the disappearance of Neanderthal man up to the present.

It is this really marvelous advance to which our attention must now be given. There is no question among anthropologists of the great improvement. All are agreed that in body, brain, and culture we have a man far surpassing all that went before.

II

The stations in which men of the Cro-Magnon type have been found stretch from Wales on the north to Italy on the south. In almost every case the skeletons showed more or less care in their burial, and in a number the posi-

tion of the body and the accompanying implements showed that the burial was distinctly a symbolic ceremony. Human life has come to have a real dignity and worth, and even the body of the dead was treated with real honor. The Welsh skeleton is known as the "Red Lady" because the bones were actually painted red. It was found as early as 1823, but it was not until similarly built skeletons had been found elsewhere in considerable numbers that the character of the Welsh skeleton was carefully studied and its relationship to Cro-Magnon was recognized.

In 1852, in the village of Aurignac, well up the French slope of the Pyrenees in a large cave, a group of skulls and mingled fragments of skeletons was discovered, and these bones were given "Christian burial" at the direction of the authorities of the village. Subsequent discoveries in the floor of the cave beneath the spot on which the pile of bones had laid, and in the talus-covered slope in front of the cave, disclosed what have proved to be the type specimens of Aurignacian flints. When it was quite too late, it was realized what a splendid opportunity to study the men who had used the flints was lost when the bones were transferred from the cave to the cemetery.

It was not until 1868 that the Dordogne neighborhood in France, the crowded stage of the greatest number of discoveries of the work and the remains of primitive man, yielded one of its finest returns. After digging away a considerable amount of earth from the hillside in order to make road repairs, the workmen uncovered a large rock which proved to be the projecting top of a shelter now completely buried in soil and loose rock. Far beneath this

shelter were found some of the finest human skeletons that have ever been uncovered. The skeleton of the male, known now as "the old man of Cro-Magnon," is the real hero of a magnificent history that, in spite of its scientific accuracy and its detached character, often reads like a romance, Dr. Osborn's "Men of the Old Stone Age." This book so fascinated President Roosevelt that he promptly wrote a most stimulating summary and appreciation of the book for the *National Geographic Magazine.*

The contrast between this skull and that of Neanderthal man is so striking as to make it clear that here was the greatest advance in the history of man in Europe. Here is the arrival of the man who is to accomplish all that has since been done. Here is Homo sapiens.

This does not mean that the bones we are describing would be mistaken by a trained student for modern skeletons. These had their peculiarities, but they did not indicate that skeletons were those of a lower type. They are different, but just as good.

The head is large—modernly large. The capacity of the skull is quite up to, perhaps a little above, the present average of American men. The head is extremely long and narrow. Strangely, this did not make the face narrow, as is usually the case in long-headed people. The cheek bones ran far to the side, of course carrying the muscles of the cheeks and temples with them. This combination of a broad face with a narrow head has been called "disharmonic," and constitutes the great individuality of this type of man. The eyes were closer together than ours, and were longer from side to side and narrower from top to bottom than ours, but this is less

noticeable than the width of the face. The teeth of the upper jaw sloped forward rather strongly, but the fine chin, a new thing in the human face, redeemed what other-

FIG. 40. SKULL OF CRO-MAGNON TYPE FROM MENTONE, AFTER THE ABBE DE VILLENEUVE.

wise might have been a protruding mouth. The forehead was high and its front erect, here again a great advance over his predecessors.

The height of this man was as commanding as the structure of his head. He measured only about one inch short of six feet. His compatriots later discovered on the Mediterranean shores of Northeastern Italy, along the Riviera, ran in various cases from two inches less to four inches more than six feet tall.

Such stature has rarely been exceeded anywhere else in the world except in odd individuals, in whom the "Giantism" was really an abnormality.

In Dr. McGregor's noble restoration of this splendid type of man we feel at once the dignity that has come over the man since we looked at his last predecessor of Magdalenian times. This man has the mechanism for thinking. He is not the passive recipient of waves of feeling roused by what he sees and hears. This man "puts two and two together" and gets an abstract concept. He can build in ideas. He can form ideals. He can look into the unknown, and face it calmly. He can call on Powers outside himself to aid him in his living. And he did all of these things, as the pictures he painted on the walls of the cave, and the forms with which he buried his dead, amply testify. (Frontispiece, C.)

The Belgian workers, Rutot, the anthropologist, and Mascre, the sculptor, have given us an even more striking bust than that of McGregor, though perhaps not so closely held to reality. Here the man has on his forehead a chaplet of bored shells and teeth. A similar string encircles his neck and hangs on his chest. His short-sleeved skin jacket is closed at the neck with a carved bone button. Best of all, in his right hand is a very skillfully held graver with which he is carving the ornamentation on what is probably the ulna of a reindeer. This will when

Plate IV. Cro-Magnon Man, as Restored by M. Mascre under Guidance of Professor Rutot.

Taken from *Prehistoric Man and His Story*, by F. Scott Elliott.

finished serve him as the "baton," the symbol of the authority over his companions, which his size and intelligence have naturally won for him.

III

In a preceding chapter we have seen that the flints of this period show a marked advance over those of the Mousterian epoch. In the first third of this time, the Aurignacian, we found flint tools becoming more varied by far and made of longer and thinner flakes. In the second, the Solutrean epoch, we found pressure flaking carried to a marvelous degree of elegance and precision in the laurel leaf and willow leaf points. By the third, the Magdalenian epoch, the flints become subordinate and are most used for the preparation of bone implements which now grow abundant and varied, and which show steady improvement, in their construction, throughout the period.

The one characteristic beyond all others that seems added in this period is the introduction of art—modeling, carving, engraving, painting. The subjects are largely animals, though occasionally, especially in carving, the human figure, particularly the female figure, is not uncommon. Plants are rare. Animals other than mammals are much less common.

Fish are more abundantly represented than any other of the lower types. It is not unnatural that they should have drawn what they so commonly ate.

Art may have begun as personal adornment. We find now not infrequently shells, teeth and small bones perforated in such way as to suggest that they formed neck-

laces and ornaments attached to the clothing. It is quite clear from the number and fineness of the needles, which are found from England to Spain and eastward as far as Hungary and Czecho-Slovakia, that clothing no longer consisted of a single pelt, but was made of pieces neatly sewed together probably with sinews, and more or less fitted to the figure.

The bone implements lent themselves easily to ornamentation and we find many tools so adorned.

Usually we have animals in these carvings, but occasionally these are conventional, repeated designs. Now and then the mark seems to be a tally. Not infrequently the animal is represented as carrying the darts of his pursuer, sticking in his body. This almost certainly throws light on the purpose of the ornamentation. There was magic in it.

I remember well my first realization of the significance put into ornamentation by the primitive mind. There hung on the wall of my home a roughly hand-made battle axe from the Sudan, which my mother had given me on her return from a two years' residence in Egypt. Mr. Frank Hamilton Cushing, the ethnologist, was then alive, and had so saturated himself with the mind of the Zuni Indians that he was quickly sympathetic to the working of the simple mind anywhere.

The axe caught his eye almost as soon as he came into the room. He walked up to it and asked me how I came by it. Then pointing to a pattern traced by repeated blows with the corner of a chisel, and consisting of a larger square with a smaller square at each of its corners, he exclaimed, "Hello! the same old story!"

"What is it?" I asked. He replied, "Our country and

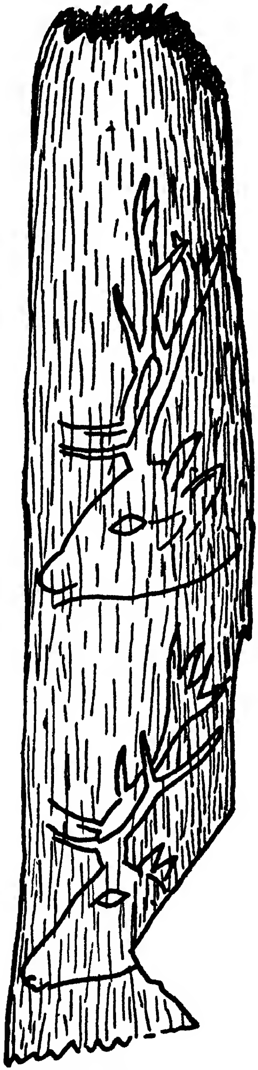


FIG. 41. HEAD OF REINDEER CARVED ON REINDEER HORN, AFTER BREUIL.

the other countries. Ours is always in the middle, and it is always the biggest."

There was another tracing, a zig-zag one, and I knew it also must have some significance.

"What is that?" I asked.

"That," said he, "is the scorpion whose bite makes the axe deadly."

So it was with the Magdalenian carvings. They brought luck, or averted danger. Hence the animals represented are usually those which man of that time used for his food, chiefly horse, reindeer, bison, ox, and boar.

In the reindeer on bone found in a Swiss cave and represented in Fig. 41 the lifelikeness and action are remarkable. The deer is grazing, and seen sidewise, as most of the animals drawn by primitive man are placed. Now and then they tried the front view, but only with moderate success. This position was too difficult for their experience. Foreshortening is a much later acquirement in art.

Almost futurist in its repetition with suggestion of motion is the row of horses on a stone in a French cave. The leader and his herd show spiritedly.

It is, however, the mural art of Magdalenian man, etched or painted on the walls or the ceilings of the caves of Spain and southern France that are the finest flower of Palæolithic art. They begin in Aurignacian times with simple outlines etched into the stone of the wall evidently with the chisel-pointed flint graver. The walls are usually of limestone and offer no serious obstacle to the patience of the worker with the flint tool. Even from the first there is a clearness and definiteness which

tells us of a stage of cruder work evolved elsewhere, before Cro-Magnon man came into this region. At first

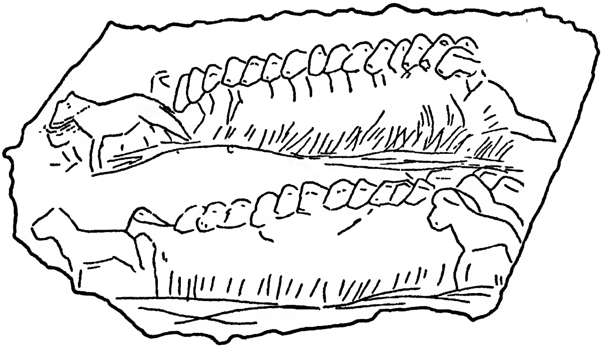


FIG. 42. ENGRAVING ON BONE OF A HERD OF HORSES, AFTER CARTAILHAC.

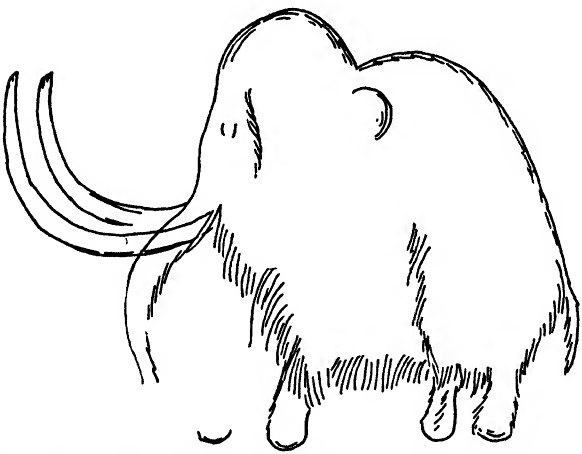


FIG. 43. MAMMOTH FROM THE DORDOGNE DISTRICT, AFTER BREUIL.

the profile was always absolute and only the two legs, on the side towards the observer showed. Before the Aurignacian period is over there is distinct improvement.

Lines are more abundant and are not confined to the simple outlines. All the legs show, though sometimes they are unskillfully drawn. In a mammoth from a cave in the Dordogne district the eye is quite misplaced, but the abundant lines of the hair indicate that here we have a hairy elephant.

Still later, color plays a remarkable part in the mural art. In 1879 M. de Sautuola was hunting for the relics of primitive man in a cavern at Altamira in Spain. He was accompanied by his little daughter who wandered about in the half light of the cavern while her father dug in the floor. Her quick cry of "Toros" (bulls), made her father look up in alarm. He saw she was pointing to the ceiling. Sending his light in that direction he saw for the first time recorded, the "polychrome" (many colored) painting of primitive man. He printed a short account of these paintings during the next year and claimed them as the work of primitive man. No attention was paid to his account at the time, because it seemed incredible. It was two decades later that further discoveries of the same sort led to the acceptance of Sautuola's claim.

In these remarkable pictures there is comparatively little engraving. In the preceding development, at first all the lines were engraved. Later the engraved line was enforced with a black pigment. Still later an even sheet of pigment spread over the figure inside the engraved lines. In the highest development of the art as found in the Altamira cave the engraving formed only apparently a sort of preparatory guide. It did not even enclose the animal completely. Red, yellow, brown, and black are the colors used. The first three pigments are composed

of various types of ocher, colored by iron compounds. The last in its best form is a manganese compound.

The outline is usually in black and is very clear and always spirited. The body is filled in with brown, red or yellow, chiefly reddish-brown in Altamira. Sometimes the color was applied dry as if by crayons. Indeed worn stumps of the blocks of ocher, evidently used until they became too small to handle skillfully, have been

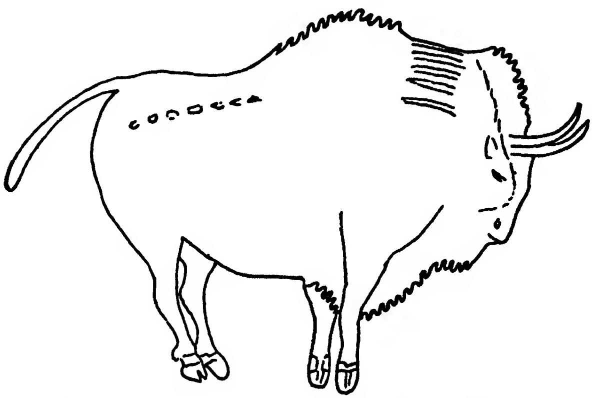


FIG. 44. THE BISON FROM ALTAMIRA, AFTER CARTAILHAC.

found. Hollow bones and sometimes shells served also as receptacles for colors mixed with fat. The shoulder blade bone of a deer, covered with paint has been found showing that it had served as a palette on which to mix the colors. In a few instances a hollow stone obviously intended to be a lamp, shows how the artist succeeded in working inside the cave. With these implements the cave was sometimes fairly covered with figures. In Altamira about thirty figures crowd, and even overlap each other.

There remains still another form of art—in some respects simpler than the preceding, the art of carving out of horn or bone or even stone the figure of the animal. It is in this form of art that we find quite a number of representations of the human form and again chiefly the female figure. To us these statuettes seem grotesque.

FIG. 45. THE WILLENDORF STATUETTE, AFTER PIETTE.

They exaggerate, to the extent of caricature the capacious pelvis and the swollen pendulous breasts. If the animals carved and painted are attempts by magical means to lure or retain in the neighborhood the animals they needed for food, these emphasized women have also a purpose. Doubtless they were intended magically to foster productiveness.

For some reason there was one other human record of which Cro-Magnon man made use. Frequently we have the mark of the human hand on the wall of the cave. Sometimes it was made by daubing the hand with paint and applying it to the wall of the cave. In this case it is regularly the right hand which was printed; often, however, the hand was placed against the wall and the paint applied all about it, leaving the portion covered by the hand unpainted. In this case it was the left hand which was represented, as the right doubtless applied the paint. Evidently man has been prevailingly right handed for twenty thousand years.

IV

In the southwestern portion of the beautiful country we now know as France, amongst the most picturesque sections is the series of little valleys carved out by the Dordogne and its tributaries. These rivers join forces with the Garonne to form the broad Gironde. This is rather an estuary than a river, and empties into the Bay of Biscay. About seventy-five miles up the Dordogne there empties into it from the northeast the Vezere river.

Between the Vezere and the Dordogne, and emptying into the former is a still smaller stream, the Beune. Each of these streams runs through limestone country and each has washed for itself a valley with more or less overhanging rocks on either side. Beneath the limestone is a layer of shale, which washes away more easily than the limestone. Hence the latter often projects beyond the shale, forming a shelter. Before houses had been built and even while they were few and simple, such

shelters formed the natural home of Cro-Magnon man. Now and then a streamlet in the country above sank into the soil to slowly eat its tortuous way through the limestone and reappear, after traversing many dark and cavernous rooms, as a spring at the junction of the limestone and the shale beneath. Here, within a circle of less than five miles' radius, and probably more than fifteen thousand years ago, was the first great art center with whose existence we have thus far become acquainted. Let us permit our imaginations to play over the indications uncovered by the quiet workers who with pick and shovel have slowly gone over these shelters and caverns.

This valley is peopled by a real community, large for those days, and consisting of perhaps eight or ten families of six or seven people each. These families were more or less distantly related to each other, and usually there were more than four or five children who had been born to each pair, but the accidents of life, wild animals, savage neighbors, falling rocks, bitter cold, carried many away. Then, too, the children mated young and left the family shelter to find one of their own. This was not a difficult task along these overhanging cliffs. This community was as large now as it could well be. When men get their food by hunting they cannot live very close together or their food runs out.

Near the confluence of the Vezere and the Beune beneath two almost adjacent rock shelters, under the same limestone cliffs lived two distinguished groups of people One of them consisted of a magnificently built man, of commanding figure, whose hair and beard, rapidly growing gray, added distinction to his broad-cheeked, narrow-eyed face. His companion, the woman who had borne

him many sons and daughters, shared for his sake a little of the regard of the community of which he was the natural leader. This esteem they would not have given to any woman not so well connected. Two young children, one of four and one of six, the only members of the family left at home, though a number lived in shelters that could easily be seen if one walked to the top of the cliff above.

The old man should have used a stick to support himself. He had had an encounter with the chief of a tribe living near the headwaters of the Beune—ten miles away. In this encounter he had come off best, but the sharp flint-tipped spear of his opponent had left a mark on the man's leg which would show for life, and which would indeed be discernible on the bone after death. But he was still the most powerful leader in the Valley and, fearless, lived in a very unprotected shelter. A few hundred yards to the south, under the same ledge, and equally near the path that led along the stream, was the other group, composed entirely of men. These were in many respects the most influential of the community, for they had powers denied to common men. They, too, could live fearlessly, for none dared attack them.

They worked in the dark of the caverns. They carved for the chief images of his enemies, and into these images they thrust darts, and the enemy sickened and even died. They carved the chief's mate her own image, but her rather slender hips they made wide. Her firm and fine breasts they made heavy and pendulous, so they brought to her fertility. Their success was shown by the fact that within a year after this image had been made, she,

who never had but one child at a time, now brought to her husband a pair of twins.

When game once grew scarce in the valley these Priests of the Powers painted on the walls of the cave the figures of the animals their companions wished to hunt. One moon later there wandered down the valley a hairy elephant. They had scarcely finished eating the flesh from his bones before a herd of seven reindeer had entered the valley. The man had put a guard above and below the herd, and then had killed them one at a time, as fast as they needed them.

But a double shadow hung over the valley. The old chieftain knew he had with difficulty worsted his rival—the young man up the Beune. This rival would be growing steadily in age and strength, and the old chief would be getting steadily older and less vigorous. It needed less power of thought than the tall man had behind that fine forehead to foretell what the end must, in all likelihood, be.

In the priestly shelter also there was a rift. The old priest had been the teacher of his little group. Under his tuition they had learned to flake their flints into gravers. Many a time he had stood with them by the sands of the stream. He had taught them to watch the animals as they came down to drink, and had made them trace in the sand the figures of the creature they picked for observation. He insisted these figures must look alive, or they never would call on the Powers to send game into the land. When one of his pupils had traced an unusually spirited outline, he sent him to cut it in the clay of the bank. So the boy learned his lesson. When he knew it well he was taken into the cave behind the shelter.

There he drew on the wall with a stick of charred wood the outline he had already made in sand and in clay. This line he cut firmly into the soft limestone with his flint graver.

The old teacher was famous, because he had learned to go farther than any other priest in that neighborhood. He had been inspired to take a black stone, a vein of which cropped out of the hillside farther down, on the banks of the big river, and he had used this to darken and widen the engraved line. So his figures looked more lifelike than any others, and down the Vezere had come the finest herd of reindeer in the memory of the old chief.

But the priest knew his time, too, was coming to an end. Two winters before there had come to join his cloister a young man whose searching eye caught quickly every curve and angle of the thing he looked at and whose skillful finger traced easily the thing his eye had seen.

When it came to tracing the figure with a bone point in the clay of the bank beneath the cliff he had done it with marvelous skill. Just a few nights before he had traced a horse, a splendidly alert figure, whose arched neck showed his untamed spirit, and whose slender and graceful legs showed his speed. The old man had looked half with pride, half with foreboding, on the finest representation of an animal he had even seen. His natural feeling was pride in the best pupil he had ever taught; foreboding because he saw his successor and was by no means ready to surrender his place.

The old priest had another problem to disturb his declining years. The wall of his cave was nearly filled with drawings. Already some of them overlapped and there was little place for new figures, while oftener and

oftener the tribe demanded that he bring the animals into the valley. He had hoped the cave would last for his lifetime; latterly he had come to fear it would not. With his young disciples he had explored every cave nearby. Only one was really at all suitable, and it did not promise as well as he liked. The pictures must be hidden from the general gaze—or the Powers would not attend them. About a mile to the southeast was a cave out of which came a small stream. It had a fairly good room. Out of the opening near the ceiling at the rear the rill entered the chamber. The old man suspected there were rooms back of this point, but to one of his age they were no longer accessible, and he had reluctantly surrendered the idea of moving into this cave.

A few mornings after the boy had so splendidly outlined the horse in the clay of the bank the priest came up the bank and looked on the horse's figure with almost consternation. Had it come to life? Not only was it outlined. The boy had returned and had cut away the clay around the figure, and rounded the edges of the projecting part until it looked as if a horse were really leaning against the cliff. This the old man had never taught. His pupil had broken the traditions of the school. The Powers might even be jealous of skill that was approaching their own. He summoned the presuming pupil, told him sternly how a young man must know his place, and sent him to the woods, ordering him to come back, in another moon, a humble and submissive pupil. The young man had gone, hurt and resentful. He had expected the master to praise, and the master had blamed.

Down the hillside he walked, his heart full of revolt. Where should he spend the time? He knew at once. He

had been with the old man to the cave that had tempted him. He had longed to enter the hole near the ceiling, but the old man had forbidden him. Now he was alone—would be alone for many days—he must find for himself a shelter. Why not in the new cave? He wandered away up the Vezere so as not to excite suspicion. Then he crossed the neck of land over to the Beune and came down that stream until he reached the mouth of the cave. He dragged into the cavern the thin trunk of a dead tree and propped it up in a corner below the opening. Thus he reached the inside and found it capacious. A few trips carried in a supply of dead wood. Then with his bow and twirling stick he soon had a fire. Ah! here was the bare wall, tempting to his budding ambition. Here he might work in his own way and as long as he chose. Looking about with a lighted torch he soon found the gallery ran far back into the rock and had several branches. Down a small slope to the right ran a trickle of water, and this told him there must be some outlet there. He worked his way down in the half light of the fire in the main gallery. He followed the trickle and soon a gleam showed him an opening in the end. It was nearly full of loose material behind which the cool water was dammed. But cool water was no obstacle to him. In a short time he had removed enough of the loose earth easily to make his way out. He found himself at a spot nearer the river and farther downstream than the entrance which they previously found. The new opening was well hidden and he felt himself quite secure.

As he sat by the side of the stream there came out of the brush on the opposite side a wild cow who waded into the stream and drank deep. Awhile she stood placidly

chewing her cud. Just then a lemming leaped from a rock to the ground, some distance up the bank. It lighted on a twig whose cracking attacted the attention of both man and beast.

The man soon realized the commonness of the event and turned aside. The cow was not so easily satisfied, and with upturned head looked and listened. The attitude caught the keen eye of the artist on the bank. Stirred by his old custom, he leaned over and traced the outline in the sand with a piece of twig. It pleased him at once and he went up the bank to a clay bed and there again he worked his model in relief. It pleased him still more. Back into the cave he went. From the smouldering fire he drew a charred stick and traced the outline on the wall. Still the likeness pleased him. From the skin bag suspended about his waist he drew his graver and slowly worked on, making the line deep and permanent. For days he labored patiently on this task, and still the likeness pleased him.

It seemed to have a strange fascination for the cow also, though that creature could never see her representation. She came often to the waterside, and every now and then she took the old position, as if to encourage the artist.

One day as he sat watching the beast there was a rustle in the bushes. This time it was on his side of the stream. Turning quickly, he saw the handsome head of a young man projecting from the bushes and looking at him in winning fashion. The stranger threw up his right hand, a form of friendly greeting that proved his weapon hand was empty, and the young priest then threw up his hand in return.

It was a momentous meeting of the two young men, each of whom had revolted against his superior. The stranger was the young chief from up the Beune who had made the unsuccessful attack on the old chief of the Vezere. The artist-priest was the young man who had been driven out from the school of the old priest for his unholy innovations. What more natural than that they should make friends? Day by day they met and day by day they came to understand each other better and to realize the kinship of their ambitions.

One morning the priest took his new friend into the cave and showed him the cow, on which he was working. The chief stood in amazement watching the lines grow. The next day he came and watched again, and when the artist drew from his bag a block of black manganese ore and darkened the outline his friend's admiration grew. Finally he broke out, "Why not make it all black?" The priest was startled at the thought. This again was going beyond the traditions. But he had broken with the traditions and it was late to hesitate now. So he blacked it all over, and it certainly made the animal stand out as it had not done before. As the picture now stood, it splendidly satisfied the young chief, but the priest felt there was something lacking. Then, too, it had taken his entire block of manganese to blacken it in.

The next two days were consumed in a trip to the Dordogne for more black rock. As he broke it loose from the ledge he noticed that the rock through which the black vein ran was red on each side of the vein and farther away from the vein was yellow.

Suddenly the thought came to him: Why not color the image with the color of the animal itself? So his

return trip found him burdened with a heavy load of yellow and red and black crayons which were to help him in his work.

The next day the young chief came again. This time he had a new proposition. "You join with me. You be the new priest and I'll be the new chief." The audacity

FIG. 46. THE ARCHER OF LAUSSELL, AFTER LALANNE.

of the thought abashed him at first. But he realized the old priest was nearing his end. He realized, too, that there was a touch of jealousy in the impulse that had made the old man send him out into the forest for a moon. Ambition began to seize him and he agreed to consider it. "Come with me to my cave up the Beune and we will talk it over and make our plans."

Once in the home of the young chief, warmed by his

fire, fed by his young and hearty-looking wife, the priest easily fell in with his plans.

The first step the artist-priest took was to carve on the walls of the cave the stalwart figure of his warlike friend. And here again he went farther than he had gone before.

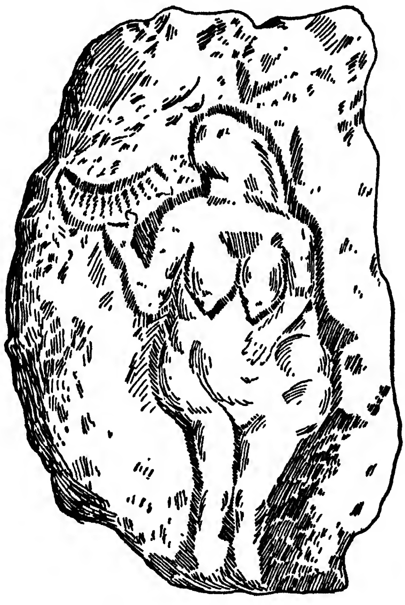


Fig. 47. The Woman of Laussell, after Lalanne.

He cut away the rock around the figure and rounded up the figure itself, as he had done with the clay horse. He figured him as pulling his bow, and he chose such a position on the wall of the cave that the arrow pointed straight to the home of the old chief down on the Vezere.

Then said the chief, "Carve her too," and he pointed to his mate. "I want many children if I am to be chief."

So the artist set to work once more and here again he bent his new image to its real purpose. He gave her a breadth of body that could be the comfortable home for many children. He gave her breasts that would give her children abundant food. In her hand he placed a big horn from whose contents she might feed plenteously in order that her children might also be well nourished.

The next morning they started together for the cave of the priest. They reached it before the sun came to its height. As they neared the cave, a bison broke from the thicket at the foot of the hill. It ascended a neighboring mound, arched its neck, and pawed the ground. At once the artist traced its figure on the sand, and then in clay. Finally they went into the cave and he began his work. As before, he traced the outline in charcoal. As before, he cut the outline in the rock with his graver. This time he marked the figure only lightly and in its more important lines.

Then with his block of yellow ocher he covered the space. With his red ocher he deepened the color over neck and shoulders. With his manganese he blackened the outlines, and deepened the shadows on the head and the lower side of the body and the figure stood complete, satisfying even to his ambitious eye.

A few days later the two young revolutionists were walking along the river bank when they came across a man from the Vezere camp. He had a strange story to tell. The old chief had started the evening before to climb the ascent from the river to his cave. It was not steep, and in his younger days he had run up it easily. This time the old man had started at his usual pace. Half way up the hill he had stopped, grasped his throat with both

hands, thrown up his head and fallen back, dead. The young chief looked with intense meaning into the eyes of the artist priest. The figure of the archer, carved on the wall of the cave, had done its work. The Powers were with them.

Together they walked to the cave of the Vezere chief. His mate was sitting stolidly beside the body of the old chief, while the young men, under the direction of the priest, were preparing the grave. They laid the old man on his back and crossed his hands. By his side they placed a large piece of roasted meat. About his head they put his kingly chaplet of shells. Around him they laid his best weapons and his keenest knife. Then his mate came and knelt with bowed head at his feet. A quick blow on the head from a stone axe in the hand of the priest, and she sank at the feet of her master, whom she could thus accompany into the darkness.

The cluster of pupil priests covered both bodies, and were about to retire from the shelter when they saw the young Beune chief and the young priest standing at the mouth of the cave. They realized at once what that meant. This was the only man who for years had had the courage to withstand the old chief. At a gesture from the new chief, the men went to the cliff above. They loosened the soil and pushed it over the edge of the projecting rock. When they were through the entrance to the cave was closed. A gesture to the old priest, and he withdrew—deposed.

A new era had come in the valley. The chieftainship had shifted from Cro-Magnon to Laussell. The Les Eyzees cave of the priests had given way to Fond-de-Gaume.

Little could they have dreamed that fifteen thousands of winters later men would find the old man's skeleton and the woman's skull with a hole in it; and the archer and his fertile wife; and the ox and the bison and many other figures which in the years to come the new school of priests, with a new technique, placed on the walls of the cave.

CHAPTER VIII

The Ice Age

The study of modern glaciers. Moraines, new and old. The ice age in Europe and in America. The possible causes of an ice age. Man and his relation to the ice ages. The effect of the ice age on Man.

I

For many hundreds of years the glaciers of the Alps have been a source of wonderment and of delight to the people of Europe. As soon as travelers began to take sight-seeing trips into countries other than their own the Alps were a favored ground. Nothing about these mountains is more remarkable than their wonderful Seas of Ice, Rivers of Ice, or whatever name may be given to the glaciers which slowly, steadily, relentlessly push their way down into the valleys from the heights above. The avalanche which suddenly hurls into the valley its confused mass of snow, ice, rocks and trees is more terrifying in its suddenness and unexpectedness, carrying, as it often does, ruin in its train. But its effect is small compared with the tremendous influence the glacier has had on the life history of the earth and of its inhabitants.

There was mystery about the glaciers. People fell into the deep cracks which stretch across the glaciers,

and were seen no more. Or still more remarkable, when nothing but tradition remained of their loss, out of the lower end of the glacier a body was pushed, so story said, and the tradition and the body were coupled together. So stories arose of old people who recognized companions of their childhood who came with all their youthful freshness on their faces, preserved, unchanged through many years.

Then came the time of careful study. Scientists camped by the side of the glaciers or even on their surface, and studied their motion. Tyndall's book on "Forms of Water" is a most interesting account of how he studied the form and the character of the movement of ice in a glacier.

There is, perhaps, no better book than this of Tyndall's from which the reader not trained in science may gather the "Method of Science," the way in which the capable and conscientious scientist goes into the search for truth. When the investigator works in this way, he comes out with a result as nearly trustworthy as any information man can gain.

Tyndall drove a row of stakes in a line across one of the glaciers of the Alps, and put a stake in the ground, on each side of the glacier and in the same line with those on the ice. Day by day the position of these stakes was noted, and their position plotted on a diagram. By the end of the summer it was quite evident what was the character of the movement. When the glacier stretched out in a straight line, the stakes in the middle of the surface moved fastest and hence, farthest. The nearer the edge the position of the stake, the slower was its motion. If the glacier stretched around a curved bed,

the stakes near the middle, but towards the outer side of the curve, moved the fastest.

Tyndall found a great cleft in a rock along the side of which the glacier passed. He drove a series of stakes in a vertical line up the side of the mass of ice and marked their change of position also. Here he found that the uppermost stake moved the most rapidly and the lowermost stake most slowly.

Moreover, he found that the movement was slightly more rapid on a warm day than on a cold, and was noticeably more rapid in summer than in winter. When the bed was steep the movement was more rapid than when the slope was easier. If there was slight change in the steepness of the bed, the ice accommodated itself to the change. If the alteration was greater, a crack formed across the glacier over the line of change. This crack moved down some distance when a new crack formed above, and the block of ice thus separated leaned forward, closed in the lower crack and the ice was once more solid. The whole nature of the movement showed that the ice was not slipping down the mountain side, but actually flowing. The movement was slow, much slower than would have been the case if the glacier had been composed of tar. But just the same, it was really flowing and not sliding.

Tyndall further found that as the river of ice, for so a glacier may properly be called, flowed down a valley, rocks rolled down from the side hills upon its surface. Sometimes it passed by the base of a cliff and the frost loosened stones from the surface of the cliff and they dropped upon the ice. As the mass moved steadily on,

a long row of stones was thus formed along each edge. Such a line is known as a lateral moraine.

Very frequently two glaciers join each other, coming out of separate higher slopes and flowing into the same lower valley. As the two rivers of ice flow together the moraines on the side of each nearest the other joins with its neighbor and they combine to form a medial moraine. Sometimes three glaciers run together and then there will be two lateral and two medial moraines. Each new addition makes a new medial moraine out of two laterals. Some of the larger glaciers have quite a number of such lines of stones running down the surface.

Steadily this stream of ice, with its burden of rocks, moves down the valley. The icy mass keeps on until it reaches a region so warm that the end melts off as fast as the ice moves down. This marks the end of the glacier. In summer this end will be farther up the valley, in winter farther down.

When the ice melts, the stones of the medial and lateral moraines naturally fall off and pile up at the bottom of the glacier, forming the largest moraine of all because the rest are continually adding to it. This end pile of stones is known as the terminal moraine.

In summer, when the end of the ice is higher up the valley the stones are strewn in front of the glacier. As the days get colder, the end of the ice pushes slowly down. Its force is tremendous. It pushes the stones lying in front of it as far as it goes, adding them finally to the great terminal moraine. Occasionally a very hard winter will make the ice come farther down than it has for years before. Then it bodily pushes the sometimes enormous terminal moraine with a grind and a crunch

that is said to be often terrifying and always awe inspiring from its evidence of marvelous force.

This terminal moraine usually lies in the form of a semicircle in front of the glacier. When a long summer makes the end of the ice withdraw up the valley the water from the melting ice draws up back of the moraine.

Since much of the water comes from beneath the glacier it is milky from the presence in it of rock, ground to a powder by the motion of the ice, carrying imbedded in it stones that scar and scrape the underlying rocks. This water is impounded behind the moraine in a lakelet and here it has a chance to deposit more or less of the fine rock powder in beds that are coarser or finer depending on the season and the varying rate of flow of the stream. These beds of fine clay have lately been much studied and their layers painstakingly counted like the rings in tree trunks, in an effort to get some idea of the age of the glacier.

When in summer the end of the glacier has retreated somewhat, especially if there is a break in the terminal moraine that allows the water to drain off, it becomes evident that the stones pushed along under the mass of ice are deposited above the terminal moraine in long hillocks that run in the general direction of the glacier's course. These are known as drumlins, and are quite conspicuous in country previously glaciated.

II

After the structure and work of glaciers began to be reasonably understood it took little power of observation

to see in the valleys of the Alps—and all of our ideas of glacier action rest on the early studies in the Alps—traces of glacial action much farther down than the present limit of the ice. In the case of many of the lakes with which Switzerland and Southern Italy abound, the existence of each was clearly due to the presence of an old terminal moraine damming up the stream which ran down the valley. Old valleys, which under the effect of water alone would have been V-shaped, were very markedly U-shaped, as a result of the wearing of the wide mass of ice.

In many valleys, tributaries which joined the main stream from side notches had a long leap from the cliff at the side of the main depression down into its bottom. This clearly is because the main valley carried a deep and strong glacier which originally filled it at least to the level from which the side stream now takes its final leap.

III

When Tyndall visited the Alpine glaciers he left a hut which he had built for occupancy while engaged in his study. This later was used by Lyell when he made his investigations on the same glacier. Lyell employed a young Swiss naturalist, Louis Agassiz, to help him in his work, during the summer, when the latter was free from his professional duties in the Swiss University of Lausanne. In this way Agassiz gained an intimate knowledge of the work of glaciers and the effect upon the landscape of the former action when they extended farther than they now do.

When the Lowell Institute in Boston invited Agassiz

to come to America for a course of lectures in their Auditorium, he was so charmed with a country that had a population which would turn out by the thousand to hear scientific lectures that he determined at once to cast in his lot with the United States. Shortly after, he became the Professor of Zoölogy at what was then Harvard College. He made trips throughout much of the United States to see the country and to gather specimens for his museum. He soon recognized that the whole northern part of the country showed traces everywhere of the presence of such glacial action as made the present Alpine glaciers seem puny indeed. Moraines, drumlins, boulders, scoring, tumbled soil he found on every hand. Then began a series of studies by American geologists which has steadily run parallel with the work that has been simultaneously carried out in Europe.

It is now very plain that there are many glacial traces over North America, and that their southern limit is quite definitely marked. There are many terminal moraines, but the great moraine, the one specifically meant when one is mentioned, is the one that marked the widest southward extension of the ice sheet. This is plainly shown along Cape Cod. It forms Martha's Vineyard. It is the backbone of Long Island on the hilly northern side, as seen at Oyster Bay, while its outwash, and the sand washed against it by the ocean form the flatter southern portion as seen about Mineola. The moriane runs past Ramapo into northern New Jersey. It enters Pennsylvania just below the Delaware Water Gap, passes northwestward out of Pennsylvania into New York State. Then it returns to Pennsylvania, passes near Pittsburgh, across the Pan Handle of West Virginia, and into Ohio,

where it descends nearly to Cincinnati. It runs westward through Indiana covering most of that state and all but a very little of Illinois. It goes through Kansas, up into the Dakotas and on out to join a similar line, not so well studied, over the great Rocky Mountain region.

It is quite clear that at one time an enormous ice sheet spread over all of Eastern Canada and all the region down to the line just described.

The center from which it moved lay northeast of the Great Lakes. All this area now shows unquestioned signs of glaciation. The prairie portion of this region is made up of transported soil covering and completely obliterating the old river systems. This layer of "drift," as it is called, varies from a few feet, say thirty, at the lower border of the region, to nearly five hundred feet in the Cleveland section. It is covered with level prairies, swamps, and lakes, the first being most abundant farthest down, the last as we reach the neighborhood most recently abandoned by the ice.

All over this area are boulders which are entirely unlike any native rock of the region. Just outside a railroad station in central Indiana is a stone of the character found in place about Mackinac Island and not farther south, except, as in the case of the Indiana specimen, as a boulder. All about the Chautauqua Lake are big stones of the kind found in place in Canada. In a stream in west Central Illinois was found a mass of native copper, clearly from the Lake Superior Region.

On Kelly's Island in Lake Erie, wherever they uncover the limestone rock of the region, its surface is scored deep with great scratches and flutings, carved by the stones carried in the bottom of the ice and making it

act like a great file. These scorings show better in limestone because it does not crumble out and crack away so easily as does the harder granite. But even the granites are often plainly scratched by the passage of the glaciers.

As the ice melted back, enormous stones were gently let down on a hard stone surface beneath. Occasionally it happens that such stones are balanced on so small a point that it is possible to rock them. Such a "rocking stone" is seen in the Bronx Zoölogical Garden in New York City.

Europe was just as heavily glaciated as was America at the time of the greatest extension of the ice. A vast sheet spread in all directions from the mountains of Southern Norway and Sweden. The ice flowed north into the Arctic Ocean; eastward it obliterated the North Sea and flowed over Scotland and Ireland and all but the southern fifth of England. It flowed south over Holland and the northern half of Germany, where it nearly met another, coming north from the Alps. It extended over the northwestern fourth of Russia.

IV

Those who are familiar with the state of Indiana recognize the great gravel banks at the bottom of the state, marking the lower limit of the flat lands. Below this the streams run in ravines, and even the superficial observer can see that the country is like Kentucky, on the other side of the Ohio River. But when he comes into the northern part of the state, for example, in the region occupied by the Winona Chautauqua, he will recognize in their so-called "Indian Mound" not at all the character of mound made by our Indians but really a part of a terminal moraine.

Going farther north, still another ridge will prove to be a terminal moraine.

Here there are three great moraines—three glacier ends. Of course, the one farthest south is the oldest of the three. There are even evidences that there was once a moraine not so far south as the lowest is now found, but that it has been almost entirely obliterated by the glacial sheet which left the most southerly line. This means that there must have been a strange pulsation in the growth of this ice sheet. It must have come down; then it must have melted back; then come down again; then melted back, in at least four great waves of advance and recession.

In Europe there are evidences of a similar series of pulsations. For instance, the glacier that went farthest, nearly covered England, leaving only its southern shores untouched. A later one extended only half way down through England though it completely covered Scotland and over two-thirds of Ireland. A later pulsation did not cross the North Sea at all, but carved the Fiords of Norway. But the same cold era covered the mountain tops of England and Scotland with glaciers where there are none to-day, though hosts of beautiful lakes scored by those glaciers and dammed by their terminal moraines make the district a delightful resort for tourists.

V

What could have caused the great changes in the climate which only could account for this apparently terrific refrigeration?

We must not overestimate the amount of change needed to produce these effects. There seems to be an agreement amongst geologists that a lowering of the temperature of these regions by an average of ten degrees for the entire year would produce it all.

That the poles have not always been surrounded by the dreary ice fields which cover them today is plain, because we find fossil tree ferns in the rocks of Iceland.

It is only proper to state that no one has clearly persuaded the scientific world that he has fully accounted for Glacial Eras. No explanation will avail unless it can bring repeated action of the same kind. This ice age we have been describing is not the only one the earth has known. Almost all the great ages of the Earth's history have seen at least one, and it commonly marked a great transition in the life forms of the earth.

Dr. Lull of Yale, in his remarkable chapter, "The Pulse of Life" in the Yale series on "The Evolution of the Earth and Its Inhabitants" speaks of such a time of lowered temperature, and glacial conditions as having formed the stimulus which led to the development of the backboned animals at the beginning of the Cambrian; of the warm-blooded animals in the Permian, and of Modern types of mammals in the Eocene.

The most fascinating of all the theories to account for our glacial period is that known as Croll's Hypothesis. The earth travels around the sun in an ellipse, not in a circle; that is, in a path such as would be formed out of a hoop if it were pressed a little, so as to make the diameter shortest in one direction and longest in the direction at the right angles to this. The sun, too, is not in the

center of the circle, but in one focus of the ellipse, which is to one side of the center. The nearer to the sun a body travelling about it is at any particular moment, the faster it will advance. Hence the earth moves fastest when it is in that part of its path which lies nearest the sun (perihelion). This is not the cause of summer and winter, or the same season would come at the same time in both northern and southern hemispheres. As a matter of fact, in Buenos Ayres Christmas comes in summer. It so happens that summer at present comes in the northern hemisphere when we are farthest away from the sun (aphelion).

The seasons are due to the fact that the earth turns on a leaning axis. When our end of the axis leans towards the sun we have summer, when it leans away we have winter.

Slowly, however, this axis sways like a "drunken" top. Long ago it was so placed that it brought summer in the northern hemisphere when we were nearest the sun. This would make the summers hotter than they are now and the winters colder, and the average not far different. But then the earth sped through its course fastest in summer and more slowly in winter. That is, it hastened through its shorter, hotter summer and delayed in its longer, colder winter. Then, too, the hoop is sometimes flatter than at others, the orbit is more elliptical, and this also makes a difference.

This theory of Croll's would certainly account beautifully for the change. The trouble with it is that astronomical events, dependent on the movement of the heavenly bodies, are the most regular in their occurrence of all

the phenomena in Nature. If this alone were the cause of the extension of the glaciers it should recur with uncompromising regularity about every ten thousand years. The time between some of the pulsations is far greater than that, and the time between this last great glacial epoch and the one preceding it is incomparably longer than that. There must be other causes which, alone or in coöperaton with these, would bring about an ice age.

The line along which the sea and the land meet is constantly changing its position. That is, there is a gradual change in the elevation of the land, any neighborhood sometimes pushing up, sometimes sinking or being weathered off. This change in elevation will bring about changes in the climate of the region and serve to intensify the effect of any other causes that may be operating.

These variations in elevation may alter the level of the sea floor as well as of the mainland. This might happen in such a way as to materially affect climate. For instance, there is a ridge across the Atlantic between Newfoundland and Ireland, on which all the earlier telegraphic cables were laid. If this elevation should be pushed near the surface it could seriously affect the amount of warm water from the Gulf Stream which would enter the Arctic Ocean. Cutting this out would materially lower the temperature of all the region adjacent to that northern water.

When the southern summers are long instead of the northern the whole series of ocean currents is shifted southward and this might also greatly affect the amount of warm water which could flow north of the British

Isles, and consequently such a change would lower all northern temperatures.

A recent theory to account for the ice age is that changes in the amount of carbon dioxide and of water in the earth's atmosphere have much to do with alterations in its climate. This gaseous envelope acts to the earth like the glass on a gardener's cold frame. Radiant energy from the sun penetrates it readily. When these rays strike the earth they are converted into heat, thus heat is quite effectively blanketed by the glass, or the atmosphere, and kept in contact with the earth. The greater the amount of carbon dioxide and of vapor of water present in the atmosphere the more effectually it blankets the inner heat.

If a half dozen horses were all running steadily about a race course, each maintaining a speed of its own, different from that of all the rest, we would notice an interesting fact about the condition of the track. The horses would commonly be scattered irregularly about the course, their relative positions varying constantly. Often two of them would be near each other. Less frequently three of them would bunch together. It would happen now and then that four would be in the same part of the track at the same time. It is plain that sometimes five, and far more rarely, all six of the horses would meet.

It may be that this is the secret of the apparent irregularity of the glacial periods. They tend to be caused by each of the above activities, and perhaps others not yet discovered. No one of them is big enough of itself to cause a glacial period, but whenever several of them concur, their combined effect may be enough to produce the amount of cooling which brings on an ice age.

VI

It has been mentioned earlier in this chapter that four great waves of cold produced four great advances of the ice sheet. These have been well studied on both sides of the Atlantic, but for our present purpose, the understanding of the relation of these changes to the evolution of man, it is evident the European studies are more important. We have found the evidences of the presence of man, or at least of manlike forms, in the old world through all these changes. Man seems to have entered America after the close of the last glacial period.

Hence, anthropologists are accustomed to speak of these successive cold waves by the names given them by the European students, and lately, particularly by the names given them by Penck as a result of the traces of glaciation along various streams in the Alps. He called them in their order Günz, Mindel, Riss and Würm.

To the first great advance of the ice in our (Quaternary) ice age, Penck gives the name of Günz. When this was over there came a long interglacial period before next it grew cold and the ice returned in the Mindel glacial time. This warmer interval between the two colder terms is known as the Günz-Mindel Interglacial.

It will make these names a little easier to remember if we notice that their initial letters have the same order in time which they have in the alphabet: G, M, R, W.

The Würm glacial was not the end of the cold waves. Three or four minor pulsations, each milder than its predecessor, brought to its close the glacial epoch and ushered in the present, which we call the Post-Glacial time. Yet we cannot be certain after all that the glacial epoch

is over. The time that has elapsed since the last great advance of the ice sheet is far less than the length of some of the interglacial periods, and it is not at all impossible that we are in interglacial and not post-glacial times.

It is very difficult to determine the length of any geological period in actual years. Comparative lengths are a little more certain. To Penck, the most persistent student of the glacial, it seems that the following is the probable state of affairs.

The third interglacial (R-W) was, at least, three times as long as the time since the fourth glacial (W). The second interglacial (M-R) was much longer than the third, while the first interglacial (G-M), though not so long as the second, was longer than the third.

It is harder to tell the length of glacial periods than of interglacial. Probably the second (M) was the longest and the fourth (W) the shortest, while the first and third were intermediate between them.

To somewhat roughly abbreviate the result worked out by Dr. Seeds, in coöperating with Dr. Osborn and printed by the latter in his masterly "Men of the Old Stone Age," we have a table something like this:

Years ago		Climate	Type of men
			All later forms
1		Post-glacial	Cro-Magnon
	40,000	*4th* glacial (W)	Neanderthal
2			
3			
4	75,000	*3rd* interglacial (R-W)	
5			Piltdown
6			
7	175,000	*3rd* glacial (R)	
8			

9			
10			
11	275,000	*2nd* interglacial (M-R)	Heidelberg
12			
13			
14			
15	375,000	*2nd* glacial (M)	
16			
17			
18	450,000	*1st* interglacial (G-M)	
19			
	500,000	*1st* glacial (G)	Java half-man
20			

Each division on the left equals 25,000 years.

VIII

In an earlier chapter we have shown how scientists attempt to account for the coming of man out of lower forms by changes in climate. The gradual rise of the mountains of southern Asia had slowly cut the warm moist wind from the country lying back of them. Gradually the trees disappeared. The tree-living animals, who were the ancestors of the apes, retreated southward with the trees and became progressively better adapted to that type of life. They differentiated into the various kinds of apes in different regions. Those that went southeast into the mountainous country which sank so that the elevated portions alone remained as a cluster of islands, now known as the Malay archipelago, became the gibbons and the orang-utans. Those that migrated southwestward across the Arabian and Abyssinian lands into Africa became the gorilla, and the chimpanzee.

But there was a more adaptable branch of these tree-

living forms. Their brains were bigger and their fingers more delicate. They were of kindlier and more sociable disposition. They cared better and longer for their young, and lived in groups of members of close kin. They were perhaps entrapped in a great forest area which melted off steadily into grassland on all sides. This prairie steadily encroached on the trees. By the time the great forests were gone these, our ancestors, had learned to use sticks and stones to help their hands and teeth, and to work in coöperation with each other.

It is easy to laugh at this story, and to call it all a figment of the imagination. If man is ages old and earlier man progressively lower, and in this anthropologists are now agreed, there must have been some such story.

If then it is to the rise of the southern highlands of Asia, or to some similar cause, that we owe the coming of man, it is to the successive pulsations of the Ice Age that we owe his development into civilization.

Dr. Ellsworth Huntington of Yale has been giving us a series of studies of the effect of climate upon human character and culture, and he makes the alternating climates of glacial times responsible for man's steady advance. Migration under such conditions is a steady process. As the climate of a region drops in temperature, the conditions of life grow harder and harder. In men of the stage of advancement we have been studying in our consideration of the Old Stone Age, men who live entirely on what they can find or chase, only a sparse population is possible. Such men need a big area over which to range if they are to find sufficient food. If for any reason the climate grows either seriously colder, or seriously drier, food becomes far less abundant. The

crowd of men then becomes too great for the neighborhood to support and some of them must leave. This does not mean that necessarily there is a general exodus. It does mean that the more vigorous and venturesome people, and those with most personality and originality venture farthest out. This process is itself selective. But those that keep moving with the frontier are exposed to unusual dangers. Life is hard, though to people of such vigor it may be far more joyous than the humdrum living with the suppressed crowd. The dangers of life cut off any who are below the rest in vigor. These combined influences of migration and severity of climate spur to rapid evolution by selection. Migrations then are fit instruments for the steady uplift of a population.

When an interglacial time is well established and rich forest regions and grassy plains are again widespread, these advanced groups of selected people have most favorable locations and they multiply rapidly. Of course there is less spur now, and the average of the group may slowly decline. It probably dies. But the numbers are greatly increased of the newer and finer stock.

Again comes a cold wave. Again the conditions of life become harder. Again men are driven to the march. Again migration and hardship work their selective effect and the reduced number of people is now far higher than in the previous glacial period.

It is the great strip between the desert and the ice that has swept man up and down, now multiplying him until there is a large body from which to select, then sending him the strenuous life that builds character and weeds out weaklings.

With each amelioration of the climate of Europe there

had crept into it a new group of people. Sometimes they came from the east direct, sometimes across northern Africa and then up. The Mediterranean bridges made the latter route easy in earlier times and not difficult, by Gibraltar even when water cut through the neck.

> "Then welcome each rebuff
> That turns earth's smoothness rough,
> Each sting that bids nor sit, nor stand but go!
> Be our joys three parts pain!
> Strive, and hold cheap the strain;
> Learn, nor account the pang; dare, never grudge the throe!"

CHAPTER IX

The Transition to Modern Times

New arrivals from the old home. What became of the old races! Were some of them transformed? The Azilian people. The Tardenoisians. The Rhobenhausen swamps. The coming type of life.

I

In our study of the story of the development of man we have seen first an older man, brutish in many of his physical characters though within him there were evidently possibilities beyond his brute appearances. Neanderthal man, low-browed, bent backed, short legged as he was, none the less was truly man.

As we knew him in Europe, he probably died out. But from his long-headed kind in the old home in Asia developed a higher and better form that when he arrived in Europe perhaps in part absorbed him, probably in larger part drove him out. The newcomer was a modern man in every physical character. Cro-Magnon man if dressed as we are could walk through the streets of a modern city and attract no attention; or if he did, it would be admiration for his stature. But Neanderthal man, no matter how modernly dressed he might be, would still look so unlike us as to be regarded with suspicion and

aversion whether we met him on the train, on the street, in the subway or even in church.

It seems as if a human race, like a human family, may rise to fine heights and then somehow, at least in the past, to have carried in itself the seeds of its own decline. Slowly the members of the family become less prominent in society; such position as they have is due more to the tradition of what their ancestors once were. This cannot last long. Gradually the family declines and new and vigorous families, perhaps stimulated by the earlier example of those they are supplanting, slowly take their place.

So it was with Cro-Magnon man. He came into Europe well equipped, he learned from Neanderthal man all the latter knew, and improved on it steadily. He had become sufficiently expert by Solutrian times to do wonderful flint flaking, and by Magdalenian times to make marvelous ceremonial paintings on the walls of the cave. But after a long history, of probably fifteen thousand years, his descendants have learned an easier way of making weapons and are content with those that are less efficient. They have forgotten the old noble art and have sunken to caricature or convention. There is as yet no entirely new kind of man to take their place. We have few indications of the physical character of the men of the transition time. When the Neolithic men, men of the New Stone Age, come in, they are not only like us, they are ourselves.

The shelter of the cave had done much for Cro-Magnon man. It had greatly lessened the exposure and the dangers of life. It may well be supposed that fewer of his children died in infancy. More of his young men came to

maturity. The fathers and mothers lived long enough to add to the numbers of the family. Man began more thickly to populate Europe.

II

All of these tendencies were fostered by the softening of the climate as the glacier slowly receded up the mountains and into the northland. A more profuse vegetation followed out of the south. But Cro-Magnon man had lived too long in the cold, and more particularly had eaten too long the animals of the cold climate to easily change his habits.

There are few kinds of mammals which can easily stand the cold, especially which can live on what they can paw up from under the snow. Fortunately for early man, the reindeer was one of these. And the reindeer not only has learned to find his food in the mosses and lichens and curled grasses under the snow; he has learned to secure safety from the carnivorous animals, whose life depends on their catching other warm-blooded animals and eating their flesh. He does this by joining himself to others of his kind, thus forming great herds. It may well be that in those earlier times the reindeer herds were even larger than they are to-day.

No people that lives entirely by hunting animals and gathering wild roots, fruits and berries, can possibly grow into a crowded community. It takes too much ground to feed a man, under such conditions. Here then were two tendencies at work. Cro-Magnon was increasing in numbers. His best food, the reindeer, was withdrawing into the north. There are two ways to meet the difficulty

successfully; one is to migrate with the reindeer. The other is to change the habits of life to fit the new surroundings. The first plan takes imagination. It requires courage. It involves abundant hardship. Doubtless the best of the men took just this plan and moved far north into regions as cold as the old glacial times in the old home. Some archaeologists believe that the Eskimos of to-day are the descendants of Cro-Magnon man. Certain it is that nowhere else in the world has there ever been another such approximation to Magdalenian culture which has lasted into historic times as in the case with these hardy dwellers in the northern snows. But their physical characters are not those of Cro-Magnon man. They are short, while he was tall. They are not only broad faced, which Cro-Magnon was, but they are mostly round-headed, while he was markedly long-headed. Perhaps these men changed their long heads to round. Somewhere in the Asian midland there must have been people who were doing just the same thing exactly. They will appear later on the scene, and will be a bone of contention for centuries in the future.

Perhaps more likely, the northern Cro-Magnon slowly gave way, largely by amalgamation with the round heads from central Asia, who absorbed the culture of the people they replaced. And this the modern round heads are still doing in their slow, relentless fashion, much to the consternation of the northern long heads, the Nordics, of to-day.

III

Perhaps the less venturesome people, those more attached to the home, tried the alternate plan. Instead

of migrating with the food, they learned a new trick. Certainly the implements which were suited to the pursuit of heavier game grow less abundant and the harpoons for securing fish become the main weapon of the chase. To the streams the people turned in their lack of reindeer food. Stags they still hunted, but stags never went in such herds as the reindeer did, and hence could not form so abundant a supply.

The flints still made by these people are apt to be very small, and sometimes they are used simply as the barbs set into a bone harpoon.

It is only comparatively recently that students have learned to distinguish a set of transition implements between those of the old and those of the new stone age. Now they are known to have been quite widespread. Indeed in the absence of the glacial coat, the stretch of country over which these transition implements are found is much greater than that covered by those of any type of their predecessors. But the period is comparatively short and gives way steadily to the full and true Neolithic.

There are three minor stations all probably existing at about the same time, that have each given name to a type of culture and each called, as is usually the case, from the name of the locality in which they are found.

The first and best known of these is the Azilian. The Arise river, in southern France runs into a great cavern. Into this shelter the Huguenots are said later to have escaped in the persecution against them. From this fact it took the name, in the dialect of the district, of Mas d'Azil (Mansion of Asylum, House of Refuge). On the bank of the stream, just before it enters the cave, is the

location in which are found the type implements of the Azilian culture.

There are two characters marking the implements which are rather peculiar to the period. One is that the harpoons, usually made of bone in other locations, are here made of stag horn, are very flat, and often have a hole

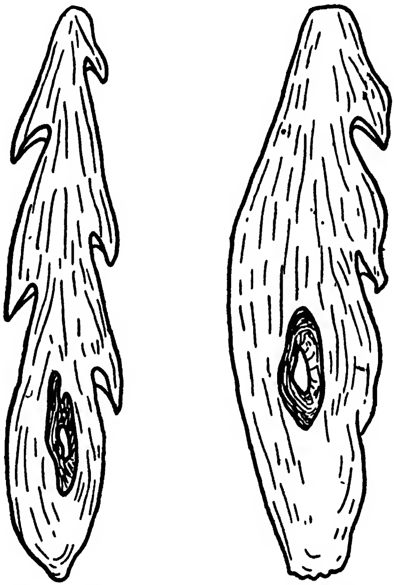


FIG. 48. HARPOONS OF AZILIAN TYPE, AFTER HOERNES.

bored at the bottom. Perhaps, like the modern harpoon of the Eskimo, the top, after fastening into the side of its victim, slipped off the wooden shaft to which it was attached by a long thong. Thus the handle became a float, which both retarded the progress of the wounded animal and showed its position to the owner of the harpoon.

The other and quite the most characteristic, of the kinds of implements of this locality is a most unusual and highly problematical one. Flat pebbles from the bottom

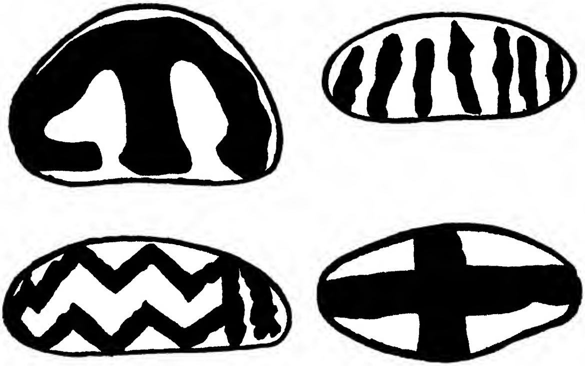


FIG. 49. AZILIAN PAINTED PEBBLES, AFTER PIETTE.

of the Arise have been painted with a red ocher grease paint, in markings which have not yet been quite acceptably explained.

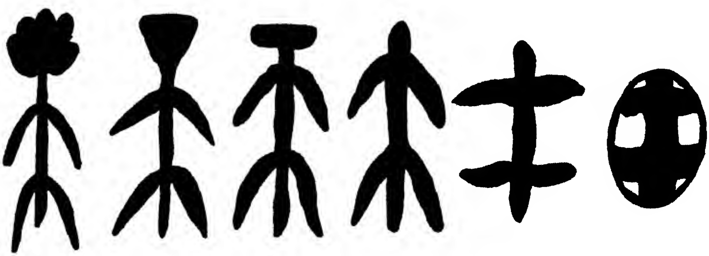


FIG. 50. SPANISH ROCK CARVINGS AND AZILIAN PEBBLE, AFTER OBERMAIER.

The Abbe Breuil believes we have the solution of the problem of these peculiar figures in the strange conventional pictures of the human form found as rock carvings

in some of the Spanish caves. He chooses such pictures, and sets them in rows. To the left end of the row he places a character which is clearly meant as a representation of the human figure. Next to this he sets a less certain representation, and the next is still less so. Finally he finds a marking which by itself would not be thought of as indicating a man, but as the end of a series, can be imagined as a conventional sign meaning the human figure. By this time he has reached a mark enough like one on the Mas d'Azil pebbles to make it possible for us to imagine that the character is really so intended.

Piette has run the series in a different direction. He finds a resemblance to certain characters in the old Phœnecian inscriptions. There he then traces them into early Greek, and later classic Greek and into the Latin. Thus he links the Azilian painted stones with the script used in modern writing. If both are right, we must have certain letters in our alphabet, which have an unbroken lineage fifteen thousand years old.

In the northern part of France a locality gives its name to the Tardenoisian culture. This is, in most respects very like the Azilian, but it has none of the painted pebbles.

Along the Danish coast there are many islands and some of these have on them great peat swamps. These often have open patches of water in them. Sometimes masses of the sphagnum moss which always accompanies peat and helps to hold it together, may form floating islands. Perhaps on some such a floating island, perhaps on an anchored raft, there lived, at the same time the Azilians were in Southern France, a group of people of largely similar culture.

The neighborhood is called Maglemose, which is said

to mean "great swamp." Perhaps we can see the name in "mighty moss." In any event, this culture is known as Maglemosean. It is very distinctly a fishing culture. Harpoons are abundant, and as in Magdalenian times are made of bone. Some of these harpoons have barbs of flint. Here, too, are found bone fishhooks. Spearing fish is too active for some people and the tribe of anglers is beginning. Many of the flint knives from this locality are nicely set in bone or in staghorn handles, and may well have been quite usable, even from our modern standpoint.

IV

This is not yet Neolithic. There is little polishing of implements and what there is seems to be the result of use rather than of intention.

Of the pottery, which is to characterize the Neolithic, there is almost none; perhaps a little, quite crude and pointed at the bottom, marks the very close of the Maglemosean.

Another characteristic will distinguish the Neolithic culture. There will be domesticated animals. There is no evidence for the presence of these in this transition period, unless in the Magelmosean a sign of the presence of the domesticated dog.

It seems quite clear that the dog is one of the first, as he seems destined to be one of the last of the domesticated animals.

It is quite clear that, in different parts of the world, different members of the wolf group have been taken into the home by man.

It is not at all difficult to imagine, and probably quite correctly, the steps in the process. From very early times man welcomed the presence of the wolf about the edges of the camp. Except in time of great hunger this animal is not likely to attack man. While other game abounds man is entirely safe. In all other respects, the presence of the wolf is most desirable. He eats the offall from the camp. The entrails of slain animals, the discarded fragments of the skin, the useless bones all would soon make a camp both unpleasant and unwholesome. A pack of small wolves will attend to that difficulty nicely.

But there is another feature of the presence of the wolf that was doubtless highly appreciated by early man. While the wolves surrounded the camp it would be very difficult for an enemy to surprise the men there gathered. The wolves would notice the presence of an intruder even more speedily than would the most watchful man. The howl of the first wolf who discovered the newcomer would alarm the others and a general howling amongst the wolves would awaken the camp most effectually.

Wherever men hunt, it is a common circumstance for them, except where game laws prevent, to kill a mother with her young about her. The young of all animals are harmless and cunning. Hunters bring them home and keep them, perhaps chiefly for the amusement of the children. It is easily within the memory of our older people when it was not uncommon to see a young bear, raccoon, opossum, fox or deer in captivity about a country home. In the west, young coyotes were often reared. After a while most of these animals became a nuisance or became ill—naturally—and had to be killed. Sometimes they were kept for a long time as pets. I doubt not in sim-

ilar fashion early man brought into the cave or the camp the cubs of a slain wolf. The wolf goes in packs. One of the necessary qualities of a packing animal is that he can learn to obey a master. The one who cannot must either be master or be killed. The young wolf in captivity soon learns that man is his master, and follows him with the devotion he would naturally give to the leader of his pack.

Everything that made the wolf useful around the camp made the domesticated wolf, the dog, even more useful within the camp. The offall could be thrown to him direct, instead of needing to be taken to the edge of the camp. At night he would lie beside the fire, amongst the men, and would be even more likely than if he were outside the camp to waken the sleepers about the fire if danger of intruders threatened. It is not at all impossible that he will remain until the last. There is more real friendship between man and the dog than between man and any other animal. The horse is a near second, but he seems doomed to lose his place. He is too big to be kept as a pet, and his usefulness is diminishing rapidly. Unless once more man learns to raise him in droves, feed him heavily, keep him from running himself tough, and kill him young and tender for food—which may well happen—his day, in closely settled countries, will likely end before very long. Meanwhile we breed new dogs for new situations and the old friendship seems in a fair way to last for a long time.

CHAPTER X

The New Stone Age Begins

Progress grows more rapid. Polished implements. The shell mounds. Their permanent character. The implements in the mounds.

I

It is interesting to realize how rapidly culture increases, when it once gets a start. The time between the Java half man and Heidelberg man is very long indeed, and the human race made what seems to us very little improvement in all that time if we judge from the eoliths which seem to be the only remnants of his occupancy we now find. They were pitifully and wearyingly alike for two hundred and fifty thousand years. The Chellean hand axe was almost a lonely accomplishment for another hundred thousand years, but it was a real starting point. When Acheulian man saw the advantage, perhaps even the beauty, of symmetry, and took care to shape his axe with regularity it was a very distinct advance both materially and spiritually. There are no people but are the better for caring for the beauty of their implements.

When Mousterean man learned to turn his attention to the pieces of flint he had flaked off in making his axe, it took him only twenty-five thousand years to make a

wide range of improvement. Then came the men of the Upper Old Stone Age, Cro-Magnon and his predecessors and successors of near kin. Within a comparatively short time, when we consider the slow progress of his forerunners, under steadily improving climate, they made wonderful advances on the finer side of life. Their art, with its steady improvement, brilliant flowering, and decline out of realism into conventionality and symbolism took perhaps only fifteen thousand years.

This brings the opening of the Neolithic in Europe to about ten thousand years ago. Up to the beginning of the Neolithic man had practically only one occupation. There were a few priests, perhaps, who were also the magicians and the physicians and the artists; all the rest were hunters. By this time the game was going. Man had to hunt new food or go also. Doubtless a few followed the old food and their successors, if not at least in part their descendants, and the inheritors of their bone-founded culture, still live in small scattered groups, dependent on fishing and hunting, and on the dog and the reindeer which they have since learned to domesticate.

Those who remained, with undoubtedly steady influx of others from the south and east of the smaller long-heads of present Europe, the Mediterraneans, become the improvers of civilization. Most of the people we know at first are in the country left free by the recession of the Northern Glacier.

The forest was too dense to be welcome. Perhaps also man who had been reared in the cold dreaded the new warmth. Certain it is that our best means of understanding the earliest Neolithic peoples are found along

the shores of the northern seas. But elsewhere there are also people of this stage of culture.

The term Neolithic, as originally given, was meant to designate the people whose stone implements were polished. We must not forget, however, that old types of implements always persist in later cultures. Our steel axe of today has almost the shape and not far from the size of the middle Neolithic stone axe, whose edge only had been ground and that to make it sharp.

We must always expect to find rough stone axes and arrows without sign of polish, in Neolithic times. Man, previous to this stage, almost never seemed to think of rubbing the margin of his tools upon another stone with the intention of giving them a better edge. Whenever we have an implement shaped by grinding, it it at least as late as Neolithic.

Men began to polish their tools in very different times in different countries. It is very difficult to connect up comparative dates before people of different countries begin to come in contact with each other. The new Stone Age began in Europe about ten thousand years ago. Doubtless it commenced earlier in the Western Asiatic plains and the river valleys of the Euphrates and the Nile. It certainly passed into the age of metals, there perhaps 5000 B. C. One hesitates to set dates to these beginnings of history when the professional historians who are most familiar with the subject differ notably. Perhaps it will serve our purpose to say that copper seems to come into Egypt and Crete at about the same time, and more than a thousand years after it is present in the Mesopotamian Valley. The use of metals does not arrive in England until two thousand or more years later.

II

Our clearest view of the earlier people of the new stone age can be gained in the great heaps of shells found along the shores of the northern seas. These are known as Kitchen Middens—which may perhaps be quite appropriately entitled kitchen dumps.

It is very difficult for any people to acquire a taste for new food. It is even hard to get most of us to try a strange food. How many of us have seen the sign "Chop Suey" repeatedly for many years and never tasted it? How many more of us, who have coaxed ourselves to eat chopy suey and found it good, have never gone forward to try chow main?

For many years, in colonial times, the love apple was an ornamental garden plant whose red fruits were feared because the plants were of the Nightshade family, and these were all supposed to be poisonous. Our ancestors picked the fruits green and put them on the high mantel shelf to ripen, for the beauty of their color. They were purposely put out of reach of the children, who might eat them and be harmed. No one now fears the love apple, that is, the tomato.

The feeling of reluctance to partake of an unfamiliar food is instinctive. Wild animals have it very strongly. It is Nature's provision to keep the young of the species from eating wrong things. The instinct remains with us, who might well learn to use our reason in guiding us in the choice of our food.

Man, finding the game growing scarce, took to fishing to help himself out. He speared his fish, as he had speared his game. Very much later he took short slivers

of bone, sharp at both ends, with a groove about the middle, tied a thong about the groove, baited the sliver and caught fish in that way. When Neolithic man first came, he inherited this method. He soon learned to make a hook of bone or shell, with a barb to it, and the groove about the upper end.

It was not long before he began to follow the streams out of the woods. As the game grew less and fish came to form a larger part of his food, he worked his way downstream, and found larger fish. The salmon had come far up in the spring, but that was soon over. Here in the lower waters there were larger fish all the year round.

Some venturesome member of the tribe had long before found the mussels, the fresh water clams, that embedded themselves amongst the stones in the bottoms of the streams, leaving only the tip protruding, to draw in and expel water. He had tried them and found them to be much like fish only more tender and juicy. So here was an added food. Besides, the shell cut about as easily as bone and could be made into beautiful beads for the adornment of his person and that of his probably much less adorned mate.

As they went farther downstream they found in the great open mouths of the rivers such shellfish as they had never dreamed of in the upper waters; oysters and clams, scallops and curled shells of many kinds, were there, especially when they got down to the shore and the conchs and naticas were added, made a great departure when once they reconciled themselves to the new food. It would seem they took to the novel diet with avidity. They camped down on the beach. They gathered the

shells, opened the oysters, clams, and scallops, and pulled out the conchs, winkles and naticas.

Doubtless they roasted many of them because there are frequent evidences of fire about. When the shells were emptied they did not trouble to carry them away. They threw them down beneath their feet and ate on. This went on for a long time, perhaps as long as the food was abundant.

It was no mere summer camp, no tribal festival, that brought them together, as was first believed when it was realized that these shell mounds had been made by man and not by geologic action of the sea rolling shells out upon the beach. When they realized that amongst these shells were charred wood, and animal bones, many of which were cracked, the meaning grew plainer. When they discovered the presence of stone implements and still more of fragments of pottery all was clear. And yet, it seemed these could not be the evidences of daily life. Slowly, however, they recognized the bones in the piles. Some were those of wild oxen, of roebuck and particularly of stag. Fish bones were found, some of them of migratory fish whose presence marked a special season, and accounted for one part of the year. The bones of wild goose accounted for another, those of the swan for still another. Some of the mammals were those who appeared only in the winter, others who were there only in summer. It was a long and patient task, and many men worked at is casually. After a while it was clear that all the year was accounted for. This was a people whose chief food must have been these shellfish, varied and relieved by the flesh of mammals and of birds. They could live along the sea now because they had

acquired a new trick of which more will be said later. Somehow they had discovered for themselves or learned from others who had discovered it that clay could not only be shaped and dried and it would retain its shape. This they had long known. Now they found that if baked it would stand wetting and considerable knocking about and still retain its form. They had the first lessons in pottery. It is a wonderful advance. First of all they could carry water. This made it unnecessary that they should live by a spring or stream. If food was abundant, and flint too, for the making of weapons they could carry water some distance. Pottery, too, even crude pottery, added a new possibility in cooking. All primitive preparation of food by heating, though by no means all food was cooked before eating, was doubtless done over the open fire. The meat was broiled or roasted. With even simple pottery, boiling can come. It does not need pottery strong enough to stand putting over the fire with water inside it. By many an early hearth are found the heating stones which the Eskimo and many Indian tribes still use. These are put into the fire until they are well heated and then they are dropped into a vessel of water, and the heat of the stone is quickly imparted to the water. This sort of cooking is particularly adapted to the cooking of oysters, clams, and sea snails. Doubtless the crabs and shrimps also went into the pot. Their shells, however, are so frail that there is little evidence of their being used.

The pottery must have been very poor. There are hosts of broken fragments, shards, but thus far not one whole vessel has turned up.

How steadily these people must have lived on their shell dumps is evident from the abundance of shards, flint utensils, fashioned bone or staghorn found scattered all through the pile. One of the largest of them would average one such product of man's labor to each big shovel full of material dug from the pile.

Some of these piles are nearly a quarter of a mile long, as wide as a good street and as high as a man's head. The number of shells in them is enormous.

A similar mound in Florida, for some of our Indians learned this trick, too, is so large that it has furnished road metal for miles of the new automobile roads recently growing up in that beautiful state.

In these shell heaps the great majority of the implements found indicate that they were shaped early in the history of Neolithic man. They are very likely to be pointed at the back as were most of those of earlier man. The front of them was ground to an edge, which is really the distinguishing mark of Neolithic man.

This grinding did not run much farther back on these old axes than does the mark of sharpening on an often sharpened axe of to-day. Thus far, it is only to get the edge sharp for cutting that the front of the axe was rubbed on a flat stone, doubtless wetting it with water and likely using a fine hard sand to help to expedite the process.

It is not unnatural that after this had been done for a time experience taught them that an axe, used for splitting wood, had better power to penetrate deeply into the cleft when its sides were smooth also. Accordingly we find this to be the next step in the polishing process.

But another step up in the advance of man is at hand. We shall speak later of the reasons that led primitive man to give up painting the walls of the cave. That had been a wonderful stimulus and an effective outlet for his artistic aspirations. That outlet was gone. He at first realizes no other opportunity and it seems as if this creative impulse were to be lost. But now it gets a splendid turn. It ceases to be the highly specialized output of a few gifted artist-priests. It becomes the common impulse of the humble artisan, and finds expression in the decoration of his most valued implement, his stone axe. He had polished it before for use. He continued the polishing process for beauty. Some of the later stone axes of Neolithic times are splendidly formed and absolutely smooth. The polishing is used to shape them into a very careful symmetry. Here beauty as well as utility is well served. The manufacture of such an axe must have been a slow and tiresome process. One can well imagine that no one man made more than a few in his lifetime. At least this must have been the case before man learned the division of labor. Then one person in the community did one thing for quite a number of others. They hunted game for him, they built his house, their women cleaned skins for him; and in return he furnished each of them with a finely shaped and highly polished stone axe. Such is the beginning of commerce. Of this there was little before Neolithic times. Each man hunted for himself. The whole tribe wandered about quite nomadically. They stopped in one place as long as the game was abundant, flints from which to make implements were easily found, and water to drink was near at hand. But a new

time is near. Man is learning new ways of living, and they are much better ways. They make the country support a larger body of people. Society comes to mean something; but this is another story and deserves a new chapter.

CHAPTER XI

The Growth of Industry

The increasing difference between men. The house of the new people. The domestication of the cow and the pig. The planting of grains. The development of basketry, leading to that of pottery. The mining of flints. Trade and commerce. Government.

I

While it is a little difficult to say anything certain about very early man when we have so comparatively few skeletons from which to judge, yet the impression is very strong that there was less diversity between early men than there came to be later on. We know only one half-man of the Java type, in all the world, and so nothing can be said there. Of Heidelberg man we know but one specimen. Of Piltdown man, while there are indications of a second, it is impossible to tell from the little we have how he compared with the one we know best.

When it comes to Neanderthal man, near-man some would say, there is less room for doubt. We have evidence of a considerable number of specimens from which to judge, and, while there are of course noticeable individual differences, the fact remains they are all very close to a

common type. This is true even when they come from mid-Europe and mid-Africa.

The resemblance between the men is no more striking than the resemblance between their productions. This is not unnatural in the case of eoliths. These are so nearly made by nature at the first and later so little touched up by man, that it is not unnatural that there should be a striking resemblance between them, wherever they are found.

Of course there is a gradual increase in the extent to which they are man modified. Yet the Ipswich flints which some men think are Pliocene are not so different from those found five hundred thousand or more years later (if the first are Pleistocene in Java, or still later in Sussex or in Belgium).

The Chellean axe is a clearly artificial product. It is what man meant it to be. It lasted for many thousands of years and is found from France to Egypt, in very many localities. There is a marvelous family likeness between them all. When Acheulian times come, the improvement is very noticeable, but again the resemblance between Acheulean axes is very great, no matter where they are found. With Mousterian times there is more variety and given localities are more likely to be individual.

The skeletons of Cro-Magnon men show more variation in size than those of Neanderthal times. There is also a larger difference of detail in the skull form. But the type is quite reasonably constant. There is, however, in Southern France an irruption of a negroid form clearly from Africa, showing that elsewhere in the world there were growing up types which were very much more dis-

tinct than those who occupied the same areas in the earlier Old Stone Age.

With Neolithic times comes a much larger variety of forms. Of the men, at first we know less than we did of their predecessors. Cave conditions were far more favorable to the preservation of the remains of men buried there. Now the tribes take to the open, and when they lightly cover men in the ground, all traces of their bodies soon disappear. When they begin to bury them in the dolmens, to be later described, often very many in one grave, the skeletons are likely to be better preserved and we know them abundantly. There seems to be almost as much variation as there is in the genuinely European population of to-day. In other words, not only are various types growing up in different parts of the world, but these types are moving about. They visit each other, they trade with each other, they sojourn with each other, they marry each other. The round head is still rare. Men are chiefly long heads, but as the age progresses more round heads will appear and in the bronze age they will be common.

The truth is we have turned the corner now into modern times. From now on we will find much in the condition of simpler people in our own lands to explain the life of these Neolithic folk.

The men of those times soon grow to resemble us much more than they were like their Old Stone Age precursors.

II

What is it that brought about this change? No one cause stands alone in bringing about this result. One

reason above all others, itself in part due to the change in climate, is the disappearance of the great herds of reindeer and the growing scarcity of all game. This forced man to hunt new food and compelled him to content himself with it when he found it. He really learned this by the employment of artifices which gave him a

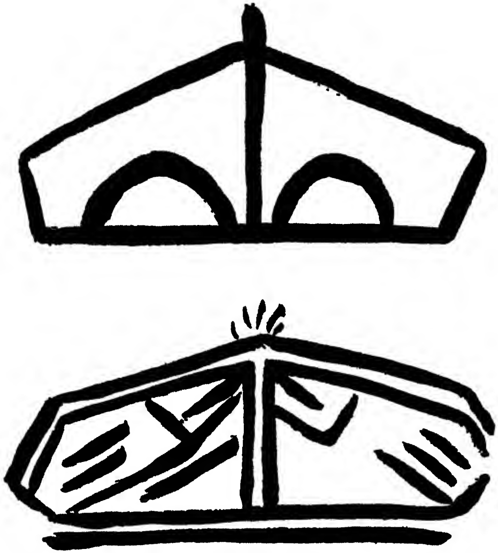


FIG. 51. HOUSE DRAWINGS OF THE OLD STONE AGE, AFTER HOERNES.

more abundant and sure supply of food than he had ever before known. This permitted him to cease moving about in search of land where game had not yet been killed out. It permitted him, at the same time, to collect in much larger groups than he had ever known before. All of this helped to make a better man of him.

Magdalenian man had probably built for himself a temporary house, when, in summer, he roamed away from

the cave in search of game. There are, in the arts of a few of the caves a small number of what archaeologists have called "tectiform," that is, roof-shaped, objects.

Men of the new stone age have left abundant traces of their homes. As with other works of men of this time, there is quite a little variation; but the farther back they go the more alike they are. One form is quite typical. It was made in the shape of a circle and was usually about five feet in diameter. The man began his house by digging a pit a few feet deep and piling the earth about it. Sometimes he also dug a trench about the outside and threw that earth on the wall of the pit. A passageway ran down from the outside. Sometimes he placed a row of stones about the slope of the rampart. Then on top of the mounded circle he drove stakes into the earth. He took boughs and wove them in and out between the stakes; that is to say, he wattled it. This still made an insufficient protection. Over the basketry of boughs he plastered clay, sometimes mixed with grass or with leaves. This made his home wind proof. A central post supported the tops of poles whose lower ends rested on the earth. This roof was covered first with boughs and then with rushes leaving a hole near the top for the exit of smoke, and the entrance of light. Now the exterior of his home was complete.

It was as simple within as without. To one side, the ground was higher than the rest. On the edge of this bench, near the fire, the occupants sat. On the bench were strewn dry rushes and on these they slept at night. Near the center of the floor a small pit, lined with flat stones, furnished a fireplace. A few loose, round firestones served for heating water.

Across the fire, near the edge of the floor, was another pit, which seems to have served rather indiscriminately for waste basket, garbage pail and catchall. Perhaps a cover of dry earth now and then kept it from becoming offensive before it received the occasional clearing out it obviously required.

In later times the house was often rectangular in pattern. The walls were higher and more carefully built.

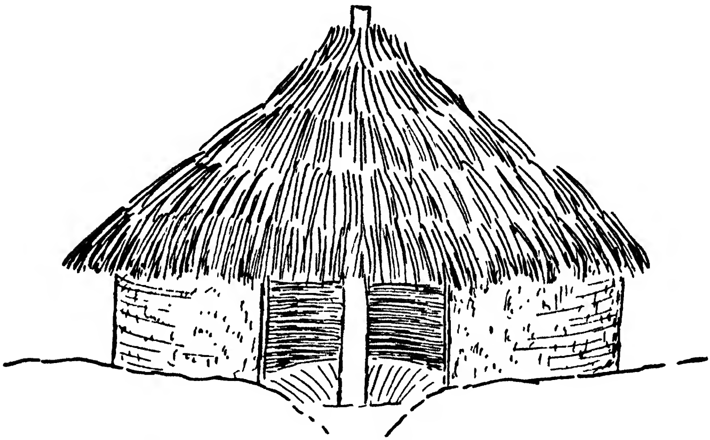


Fig. 52. House of the New Stone Age.

They were well plastered with clay both outside and inside. In addition, the inner wall seems to have been smoothed first and then washed with a thin mixture of clay and water, which dried with a smooth, perhaps a shiny surface. In the case of men of importance this inside wall was decorated with a series of zigzag streaks of white and red. On the sunny side of the house was a platform of earth on which the master of the house, and such of his family as he chose to have about him,

might enjoy the sun in winter and the air of a summer night. This begins to seem like home.

III

At the bottom of the possibility of this home, as at least the first efficient cause, lies the fact that these men are eating the flesh of animals they have reared instead of those they have killed in the chase. As the animals they hunted grew more and more scarce, it is not unnatural that it should have occurred to Neolithic man, when he killed a wild cow which had a half-grown calf by her side, to have kept this in captivity and when it was fully grown have slaughtered it for food. After this had been done for a time it is easily supposable that where a number of young were penned in the same enclosure they should have been kept until they were old enough to mate and produce their own young. This procedure would be much more reliable than hunting and the meat would be ready when it was wanted.

There must be something in the nature of cattle that makes them good subjects for domestication, since they have been so persistently and abundantly kept for so long a time and over so widespread an area. When we stop to consider the problem from this standpoint it is not hard to see what at least some of these points are.

In the first place, cattle are easily penned. Deer, even reindeer, are much more agile, more nervous, it is harder to win their entire submission. When put into an enclosure they make more attempts to escape and can jump over a far higher fence. This is a very distinct disad-

vantage to man, when he comes to try to keep them in captivity. Hence he penned cattle instead of deer.

In the second place, these animals are large and have abundant muscle to serve as meat for man; and when they placidly submit to captivity and grow lazy in the enclosure, the muscle, being less used, is more tender. This is again an advantage.

These animals, being creatures of the open ground, without dens in which to live, and particularly in which to conceal helpless young, are compelled to carry their offspring within their bodies until they are better able to take care of themselves. This is not true of the helpless progeny of rabbits or rats, whose young are concealed in burrows and holes in the ground, or of the beasts of prey who have dens in which they rear their offspring. If the calf is to be able to walk at birth it must be retained within the body of the mother until it is well grown. If it is well grown, it needs a large quantity of milk, which the mother must produce. This power to give a large supply of milk is one of the characteristics of the cow which, almost from the first, must have made her most welcome in captivity.

Again, cattle, in a state of nature, go in at least small herds. Any animal which lives a social life must be willing to submit to the leader of its pack. This docility of the cattle makes it easier for man to handle them without danger to himself. This is particularly true of the female. The male is far less docile, for a reason which is, after all, what may well have been the decisive factor.

These animals are polygamous. The male mates with a number of females whom he keeps about him, whom he protects from harm, and whom equally he keeps from the

attention of other males. Inasmuch as there are about as many males as females born, and each male tries to gather about him more or less permanent groups of females it becomes necessary that he should be belligerent. This willingness to fight always shows itself with particular violence when two males are desirous of the same female; and they battle even to the death. This fact that but one male is needed in a group of females is of enormous advantage to man. He can kill a very large proportion of the males, using them for food, and at the same time he is not diminishing in the least the fertility of his herd. Even when he does not kill the males, he unsexes them while they are still quite young. Although the removal of the glands keeps the animal from developing all the muscularity he would have formed in their continued presence, it also prevents the development of his pugnacity and accordingly makes him more tractable. So the ox became the beast of burden and later, the drawer of the plow. This he only ceased to be in our own land within the memory of those now living. Indeed, now and then a yoke of oxen may still be seen.

Another of the animals which shared most of these peculiarities of the cattle was the pig. There was particularly a so-called marsh pig, wild in Europe. This animal was not so terrifically ill tempered as the larger wild boar.

While the young of this creature were not so large as the calves they were born in such quantities as made the increase of a herd of pigs very rapid indeed. The animal, too, would eat almost anything, and could forage well for itself. A very low enclosure would pen it in. So the

cow and the pig early came into domestication when man had good pasture land and was stationary.

While he still roamed about and lived in hilly or wooded regions with scantier and tougher pasture, sheep and goats also served man's needs, and for quite similar reasons. The fleece of these latter animals added much to their value to man when he came to learn weaving, which is now also on the horizon. So, man who had hunted the wild animals until they approached extinction, realized in time that he must foster them, and that they would return his care many fold.

IV

So long as man lived in the forest where pasture was scarce, or in parts of the country where a semi-desert condition prevails it was necessary that he should be a nomad, going from place to place as pasture or water gave out. When he came down into the fertile river valleys, where vegetation is abundant, he could settle down. Neolithic man was drawn to these spots, and the result is that still another method of finding food dawns on him and becomes feasible.

Doubtless before man was man he had learned to eat the fruits and the berries. They are large, are luscious, and are easily eaten. It was much later he learned to eat the fruits of the grasses. These were not pulpy. Man doubtless early learned that these grains were rich and sweet on long chewing, the saliva turning their starch to sugar. Perhaps, like the American Indians of the Southwest, they took baskets and went through the ripe grass, beating the heads with a stick, over the baskets, which they held beneath them to catch the heavy grain.

No early European, so far as I know, had learned the Zuni trick of making a basket without a bottom, setting it on a stone, putting the grain into it and pounding it with a blunt stick. The basket keeps the fragments of the grain from flying in all directions.

Early man's method was simpler. He soon found his teeth were scarcely of a form to grind these grains well. He accordingly took a hard, nearly flat stone, which had a slight hollow on its upper surface. On this he laid the

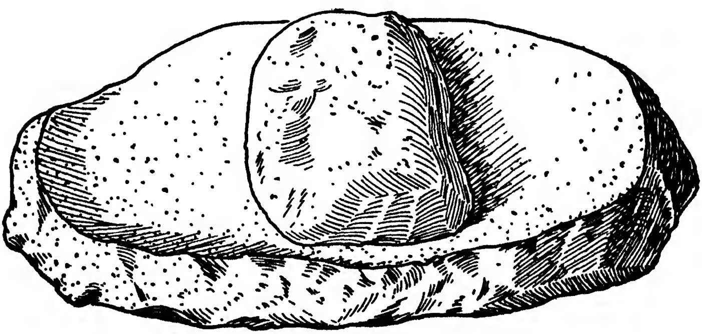


FIG. 53. NEOLITHIC MILL, AFTER REINHARDT.

grain and rubbed another hard stone forward and back over it, grinding it to a flour. This he learned to moisten with water, mould into cakes, and bake on the hot stones. We have no indication that he knew anything about raising the bread with yeast until long after this time.

We know clearly it was the women who did the grinding, because several times men have found these simple mills buried with the skeletons of the women who doubtless had used them in the life they had left, and who had also hoped they might need them in the life to come.

It is not until considerably later that man learned to

turn a circular stone, which bulged slightly on the under side, steadily round and round on another which had a hollow in which the bulge of the upper fits. This is the first really modern type of mill. The idea developed into the millstones of the water-driven grist mill which also comes down to the time of many of us now living. Indeed it is occasionally still used, though its use has been nearly superseded by the process of crushing the grain between revolving rollers.

It must have been a common accident that grains of this kind, gathered in the neighborhood, should again be lost near the camp. As long as man kept moving about this would attract no attention. After he became more likely to remain in one place, this sprouted grain would easily attract attention and he would connect it with the grass.

The transition from this discovery to the idea of planting such seeds and having them spring up about his own hut is an easy one, and must have been made many times. Now man begins to be a grower of plants. At first a digging stick is his only implement and doubtless it does little more than make a hole into which to drop some seeds. Later a hoe, often made with a clam or mussel shell as a blade, gives more effective service, and doubtless more of the competing plants were removed before the seed was placed in the ground. Then, too, there doubtless soon grew up a mild cultivation of the growing plants. A crude spade is a later tool, and this does altogether better work. This was as far as Neolithic man seemed to go. The plow comes in with the turn from the entire use of stone, bone and horn, to the partial use of metal; though when bronze-age man uses the

plow, he makes it, not of bronze, but of staghorn, as is still sometimes done in the islands of the Pacific.

V

When Neolithic man began to construct his pit-houses, with wattled walls, he started a train which has had most important results. When he put upright stakes in the ground and then took twigs and ran them in and out so as to make a more solid wall, he was learning in the large what would soon be applied in the small. Doubtless at first such pushing of the twigs between the posts was done in entirely irregular fashion. Then it was realized that if the intertwining were neatly and regularly done, the wall was closer and formed a more thorough protection against wind and rain.

But this plan is exactly the one since followed in much of the basketry made by man in all parts of the world. While the material of which baskets are made is not substantial enough to have kept, under most conditions, until to-day, we have indirect evidence of such baskets in a few of the earlier pieces of pottery. The shard has on one side of it the distinct imprint of the basketry against which it was moulded.

The walls of man's hut did not remain long merely wattled. He later learned to take clay and plaster it over the wattling; at first only on the outside; but in the later and better homes, both outside and inside were so covered and protected.

Doubtless man learned early in his history to carry and keep water in skins as is still done in many parts of the near-East. The water sellers of the Cairo streets

will deliver into your cup or even into your mouth a drink from skins for a small price. But grain would be stored in such baskets. If daubed with clay, even water might be so kept, if the clay-covered basket had been dried with a moderate heat. Perhaps it was the practice to use such a vessel to hold water into which hot stones were dropped in order to heat it. Perhaps a daubed basket was set too near the fire to dry or was forgotten and the fire heated it hard enough to bake the clay and destroy the basket. This is the sort of accident that is at the bottom of very many discoveries.

Man's naked foot, sensitive to all irregularities in the ground on which he trod, would call his attention to moist earth that slipped up in sheets between his toes and felt smooth. He had even in Aurignacian times modeled figures out of such clay. Now he is ready to make use of the accidental discovery of the possibilities of baking clay. The time for pottery is at hand.

The first pottery we know consists only of broken fragments, shards, and no complete piece remains in any deposit formed a long time after we know the shards. This early pottery, too, is very rough and quite imperfectly baked. Improvement will come later. Our experience with clay in modern pottery tells us the heating produces its effect in three distinct stages. Wet clay is plastic and can be easily modeled, but it as easily loses its shape. Hence the first step in making it permanent consists in exposing the clay to gentle heat and air; the open sun in warm countries is quite enough. This will drive out the water with which the clay is mixed. The pottery now retains its shape completely but is very fragile, and on soaking, again goes in pieces. If this dried pottery be

heated to dull redness not only the water with which the clay is mixed is driven out (if it had not all previously dried out) but actual water of constitution, chemically combined in the clay, is also expelled. Now the pottery is set and is fairly firm. Now it will hold water permanently. It is, however, not very strong. All the earliest pottery is of this sort. If the heating be continued until the vessel is white hot there is actual fusion of the clay particles and they coalesce. Now the pottery rings when struck, and if of very white clay, is slightly translucent. This sort of pottery only comes much later, with quite modern times.

The neolithic potter knew nothing of the potter's wheel. There is no such smooth and regular roundness as would have come from its use, though some of the most skillfully made is quite even. It looks as if the potter had taken a flat stone and put on it a cake of clay, that had been hand puddled until it was smooth. On the edge of this he put a rope of clay that went around the cake and built up part of the edge. Another roll was placed on top of that. Sometimes evidently, as with the Zunis of today, a rope long enough to coil, built up the entire side. The layers were pinched and kneaded until they became uniformly thick and the whole adhered well together. If the top sloped in, this part usually was made of a third section, in the vessel.

Clay alone does not make good pottery. It must be diluted with material coarser in fiber to give it consistency and to keep it from cracking in the heating. The process of adding this sort of material is called tempering the clay. The first pottery is made of clay that, as found in the pond, had enough sand in it to serve the purpose.

Occasionally finely broken stone seems to have been added. But there was no accepted proportion and no generally uniform practice. The vessels hence were not durable.

When the bowl had been shaped, the wet hand of the potter could smooth out the finger marks and all other irregularities of the surface. Tools of wood or bone or horn would also help in this part of the work.

At first there is no attempt at ornamentation, or if there is, the result is very crude indeed. Notches in the edge, impressions of fish bone, string tied about the neck, produce the early adornments. Later zigzag bands are worked into the pottery; only much later is color applied.

In the time of the cave man, art had clearly been the function of man. The artist-priest had used his art to compel by magic the return of the game or the fertility of the women. Now art comes into the daily life, and becomes the function of the woman; for it was she who made the pottery. The first efforts are very crude. The design is pressed in with a cord or a bone. Then a pointed stick traces repeated ornaments made up of very simple forms. But this is only the beginning. Before half of the time between then and now has elapsed both Egyptians and Greeks will be making vases of the most exquisite form and decorating them in a manner to equal any other art products that have ever fallen from the hand of man.

Just as the wattling of the house wall led through basketry to pottery, so towards the end of the Neolithic it led to plaiting grass and later to weaving both grass and linen. The best examples of this work from the

Neolithic have been found in connection with the lake dwellings, and the description of the beginnings of this form of domestic art will be left to a later chapter.

VI

There are other industries which spring up at this time as the natural result of the growth in population and the increased numbers of people who are coming to live in a single group. Many more implements are now demanded and there has come a higher standard of requirement for such as are used. In the earlier days there were many regions which furnished an entire abundance of flint for the manufacture of all the weapons the scattered people of the neighborhood could possibly use. Now the increased demand is such that it becomes necessary to go down into the earth, in suitable localities, and gather the fresh flints from chalk strata that lie sometimes quite a distance below the surface. At first simple pits are dug. When these have reached the level of the flints they are widened until the removal of the upper material becomes burdensome. Then a new pit is begun, and the material, dug up and not needed, is simply filled into the other exhausted pit. Thus within a small area there are often many such filled-in pits. Occasionally, when two of them are near each other, the diggers burrowed their way from one to the other. This seems to have given them a new idea.

Now we find a comparatively narrow shaft dropped like a well, to the level of the flint. Then tunnels are put out in every direction, like spokes from a wheel. To get down to the bottom of the shaft, they put a tree trunk

slantwise in the hole and cut notches in it, to make the steps of a crude form of ladder. In the tunnels they needed light and so the miner usually made himself a bowl of clay, often not baked, and plumped it on a ledge of the wall, where it stuck. This he filled with fat with a string twisted out of rushes, with its tip hanging over the edge of the bowl. The heat of this light kept the fat near the wick melted and fed the flame.

I have seen, in my boyhood, an Irish woman, in modest circumstances, using a saucer of lard and a piece of twine in exactly the same fashion. I thought it a dim light indeed. She found it enough, however, for she was darning stockings by its light.

There were as yet, of course, no metal picks and shovels for this humble mining operation. The horn of a stag with all the branches cut off except the one over the forehead was the tool with which the ground was loosened.

Unfortunately the experience of these simple miners was not great enough to warn them of the dangers. Even in the few of these drifts that have been opened up in our times to study the work of these men, several times the diggers have found the miner buried in the debris resulting from the collapse of the roof of his tunnel.

Indeed a still more pathetic story is twice revealed. In each of these cases the skeleton of a child is found near that of the man who was clearly the miner. Whether the mother was abroad at an occupation which prevented her taking the child with her, and the child had accordingly accompanied its father to his work, or whether child labor had already begun to leave its baleful trail over civilization, and the child was carrying out the flints the father dug loose, will probably never be known.

There were of course a few locations in which such flints were of finest quality and most abundant. These became the source of flints for wide areas. Men took them from village to village and bartered them. Indeed later, but still within the Neolithic, they sold them for shell money, as did the North American Indians. At least archaeologists find shell, cut so as to lead us to suspect that it was intended for such a purpose. Then too, ornaments for the person are now in demand. Beads are to be carried by the merchant. These are made of shell, of turquoise, and of amber.

The finding of these products far from home tells the story. Salt, too, is always an article of barter. It is so universally needed and so local in its occurrence that it always finds its way into commerce. Often the location of the places in which these transported articles are now found points clearly the road over which they were carried.

There are a number of trails along which such commerce naturally traveled. Chiefly they followed the great water courses. These have hollowed their way out of the hills, and form natural lines for the early traveller, who was on foot, or later, on horseback. The old peddler, who in our childhood came along the road with a pack upon his back, with odd utensils hanging about him on every side, is probably the last example of what was, in Neolithic days, the only sort of trader the world knew.

One of the earlier of the great routes between the Mediterranean and England came up the Rhone to the passes of the Juras. Then the path led down the Seine valley and up to the present site of Calais. On the English side of the channel the road soon reached the low hills known as the Downs and along the top of the South-

ern bluff, the road ran westward. Along this the products were distributed throughout southern England, then the only part of that country well provided with a human population.

The trade in cattle along the English part of this route seems to have been very heavy. At intervals there were villages and these always had a stockade to fortify them. A sort of pound for the cattle was apparently quite common.

There was a line from Switzerland north through the valley of the Rhine and another south into Italy. The Swiss Lake Dwellers evidently communicated both ways and merchants brought them pottery and later bronze from the south, while the north sent them of its amber and its flint. In later times the Danube came to be the pathway of a great traffic.

Ireland had a deposit of native gold which archaeologists recognize wherever they find it; and they trace it along these roads. France has a flint which has a fine fracture, and the lustre of beeswax. This, too, is easily recognized and helps to trace trade routes. Italy early had a very characteristic pottery which slowly spread over Europe. The amber of the Baltic was an object of much desire by many peoples. Its beauty, and the ease with which it could be worked, made it very acceptable. Perhaps, too, it early had the reputation of warding off disease. There is still a tradition that a string of amber beads will protect a child from diseases of the throat, notably, of croup.

It is quite apparent, by this time, that we are at home with these people. We have begun the modern stage in

the evolution of man, though we have not yet reached recorded history.

Communities of considerable size have grown up. There is coöperation not only between members of a village, but the English trade stations show that there were agreements between communities by which they labored for the common welfare.

Undoubtedly by this time there is a little of that division of labor, which in our day, is to have so great a development—perhaps even overdevelopment. Doubtless, too, by this time there was a beginning of a growth of classes. There were those who had gathered more of this world's goods than their fellows had, and they began to think themselves superior to the humbler folk, who had lived nearer the soil.

CHAPTER XII

The Rise of the Human Spirit

The reverence for the dead in early man. Magic in the cave drawings. Burial in dolmens. Erecting menhirs. The alinement and the cromlech.

I

When we find the skeleton of a man, dead many thousands of years, certain things about him can be quite clearly told. His height, approximately his weight, to a considerable degree his standing posture, all can be determined. What his color was must be largely a matter of surmise, with little chance of certainty. Even the color of his hair and eyes is unknown, in most cases, including all those of the men of the Old Stone Age.

Some of his habits can be clearly told from the implements we find about his old locality. To judge of matters of the spirit would at first seem entirely impossible. But we are not content to build a picture of a few of his habits. Man is more than the beasts of the field, and this more lies chiefly in his spiritual nature. Of course, then, we want to know what we can of this side of our forerunners. How are we to guide ourselves? What indications have we on which to found an estimate? The answer is simple. To some it is measurably satisfactory, in default of better knowledge. To others it is not trustworthy and

they prefer to pass the whole matter by. The method is this. Find, from the remains, what we can, and interpret these findings by a study of the people of the earth, living within recent times and often still alive, who most resemble our forefathers in the stage of their advancement, the nature of their implements, and apparently their customs.

One of two implications lies back of such study. Perhaps, as Sollas is inclined to believe, these peoples are the present backward descendants of the earlier peoples, driven from the centers of civilization by their more vigorous successors. He thinks Tasmanian man may teach us of a type earlier than Neanderthal, while the latter man is better represented to-day by the native Australian. Pressed into another direction, Magdalenian man has his modern representative in the Eskimo. If this is true, even in the sense that these people inherited the culture, though they may not actually be of the blood, then we have what are practically living specimens of our ancestral types and can study them. Of course, there have been changes of habit, and growths of custom, and for these we must allow; but the problem is not at all hopeless if Sollas is right.

The other alternative is no more universally accepted than is the hypothesis set forth by Sollas. This supposition accepts it as true that under similar conditions in different parts of the world, similar results will come out of the contact of the simple human mind with the facts of nature. These people believe that similar weapons, similar baskets, similar pottery are no necessary indication of contact between the peoples who produced them, so long as they are not too complicated.

As an illustration of this truth they might point to the fact that the American Indian came into this continent with chipped flints. Of his own accord, they would say, he learned to smooth his axe by rubbing it, making it more effective and more ornamental.

Neolithic man in the old world, made the same advance, probably made it earlier, and carried it further. But we must not infer that the American Indian learned from the Neolithic inhabitant of the old world to polish his axe. As was said before, not all men will accept this and some believe that any reasonable resemblance between products or customs implies common contact at some time, and transfer of the custom. To some of these people the shell mounds of Florida and the kitchen middens of Denmark are evidences of pearl hunters who learned from the wisdom of the Egyptians.

I think most anthropologists will accept all of these principles as at work and will interpret what they find by the hypothesis which seems to accord most nearly with the particular conditions and the special result in any case.

There are two sides of the religions of simple peoples in which all have much in common. There is doubtless much of both in the religious habits and beliefs of the simpler minded people in any religion. It is easy to call both of them, in their grosser forms, superstition. Where to draw the line between their superstition and our own religious beliefs and practices in these particular matters would certainly be difficult.

One of these is a belief that the man who has died, has continued to live in some other place, and that his needs and joys there are very like what they were when he was still evidently alive amongst his friends.

The other phase of the belief is that there are supernatural powers, mighty and mysterious, and that men, at least certain men, can influence these powers to be favorable to them.

When Neanderthal man began to bury his dead, particularly when he laid his weapons beside him, we may confidently believe the dead man was supposed to mean more than a dead mammoth. His body, dead, must be treated with respect. Doubtless this was first true mainly of the leaders. Gradually burial became more frequent. The position in the grave became more ceremonious, and probably more significant.

When man was buried in the crouched position, regularly, there was some reason for it. What was the reason? A number of modern peoples have buried their dead crouched. Why do they do it? To hold the body in this position, it must be so bandaged. One ethnologist, studying a tribe who have a great dread of ghosts, interprets the binding as being done so that the spirit of the dead man shall not wander about and haunt his old localities. Another ethnologist explains it in the case of people he knows intimately and has studied closely. He says it is the "embryonic position." So the child lay within its mother's womb before he was born the first time. So he must lie within the womb of mother earth until he is to be born again. Each is a possible interpretation under the same hypothesis of using modern peoples to interpret ancient. If one is inclined to emphasize the fact that early man was far beneath man today, he will have a natural bias towards the first interpretation. If one is inclined to think there has always been a strong element in man, making him far higher than his bodily resemblance to the

brute would indicate, he will naturally lean to the second explanation. Of course there may have been an element of both present in the custom.

When Cro-Magnon men come on the scene, the burial is far more ceremonial, and probably a larger proportion of their dead were buried. The material deposited with the body has considerably increased both in amount and value.

II

The high mark of the spirituality of Cro-Magnon man lay in his marvelous art. Again, it must be surmise, when we speak of the purpose of this art. That it is not simply "art for art's sake" is clear; if it were, it would not have been put back in holes in the ground far from the eye of man, when he is about his daily tasks. Again, we must interpret by living tribes and their customs. The things painted were animals, almost entirely. They were the animals these men used for food, in far the largest number. The main exceptions are an occasional animal that was a menace to them. We have come to interpret these pictures as meaning magic. Not magic in our modern sense of sleight of hand tricks. Losing a belief in magic, we have come to interpret other things as magic and give them a place solely in our amusement. But magic once had a far different, sometimes a very somber meaning. It was a part of religion. It was a method of placating the higher powers, the invisible forces, that ruled the happenings of nature.

These pictures were meant to keep in the country all the game when there were signs of its becoming scarce;

perhaps, even, it was hoped they would bring it back when most of it had already gone.

No people will long keep up unavailing magic. After the community became large, the game had disappeared and its place was taken by domesticated animals which could be relied upon. That particular kind of magic now was both unavailing and unnecessary. So the mural painting of the cave died out. Art took a more domestic turn, and religion was freed from that form of superstition.

With the coming of Neolithic man, it would seem as if his religion once more centered about his dead. He was no longer content to simply bury him with the things about him which he might need in the next world. Even this ceremony became sometimes marvelous. In the northern part of Europe in late Neolithic times, when the boat had become large and strong, and the conquering chief went by boat instead of on land, a new burial ceremony arose.

The dead chief, with his wife and his near retainers, his weapons and his ornaments, was put into the boat and taken out some distance from the land. A hole was made in the side of the boat, and living and dead, with their lavish equipment, accompanied the chief on his long voyage to the isles of the blessed.

III

But now a new element is added to the burial customs. Not only must the dead be buried with all ceremony and all provision for his comfort in the new life, but the place where he was buried must be marked. This was doubtless both that the remembrance of him should be kept amongst those who knew him, and that awe should

be awakened by the memory. So it came about, doubtless, that the place of his burial was marked by something that would catch the eye. At first, it seems to have been only a mound of earth, perhaps as high as a man's head. Soon after, there grew up the habit of making a tomb of two or three large upright stones with another over

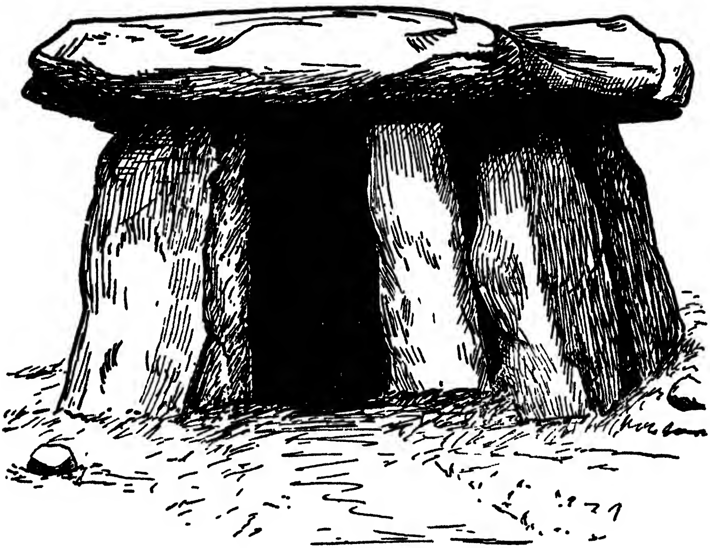


Fig. 54. A Dolmen.

the top of these. Usually a loose stone in the front closed the opening, but could be moved for a later burial, doubtless of some other member of the family. This group of large stones covering a burial site is known as a dolmen. Usually, perhaps always, it was covered with earth. Many of the dolmens now are bare, but so very many of them have been dug out of mounds that it seems likely that all of them were at first covered.

The stones used in the making of these dolmens were sometimes quite heavy. They led up to later monuments of very much heavier stones. To this whole related movement, using large stones as memorials, the name of "Megalithic" (big stone) has been given.

FIG. 55. A MENHIR.

At first the dolmen was covered with a circular mound—a "round barrow." Later it became customary to have a covered passageway of stone leading into the dolmen portion. Such an arrangement was commonly associated with multiple burials. Sometimes the room portion was

partitioned off into several chambers. The way some of the bodies had been pushed aside, while others lay, smoothly, indicated that not all the burials had taken place at one time. When such a covered passageway with its terminal chamber had been covered with earth it formed what has come to be known as a "long barrow."

Later there came a custom of taking an unusually big stone, often many tons in weight, and standing it up on end. These have come to be known as "menhirs." The largest of these, now fallen and broken must have been nearly seventy feet high. Digging about the base of a menhir rarely discloses any remains. It is usually not a tombstone. Perhaps it is a cenotaph, a memorial stone to honor one who died while far away, but whom the home people wish to honor. Doubtless sometimes it was a stone in memory of some great event—some Bethel. At times it was doubtless a dividing stone between those who had previously held the land in common, and now decided to divide it between them—some Mizpah. Out of the menhir developed the alinement. While dolmens are found over much of the then inhabited world, and menhirs, though much less common are often found, the alinement, and its later development, the cromlech is of much less frequent occurrence. Northwestern France contains as many as all the rest of the world put together. Next comes South England. Any other place is a very distant third.

This gathering of sometimes three or four lines of menhirs, each line in at least one case more than a mile long, forming a great alinement must have been not only a memorial of their mighty dead, but also a commemoration of the great events in the history of a people with

enduring traditions. An alinement near Carnac in Brittany, in the northwestern corner of France, is made of three sections each with about ten rows, and containing in all about twenty-five hundred menhirs varying in height from one to four yards, the whole extending about two miles.

FIG. 56. AN ALINEMENT.

In the highest development of this megalithic architecture, a double alinement led westward to a series of menhirs in a circle. Such a circle is called a cromlech. Inside the circle is what some interpret as a dolmen, others as an altar. England has the two most remarkable of these examples of the combined cromlech and alinement. One of these is at Avebury, the other at Stonehenge, both

of which are in Wiltshire, about one hundred miles west of London.

Avebury is the larger of the two. It consists of two characteristic parts. A double row, of upright stones, more than a quarter of a mile long leads up to what was once a set of about a hundred stones set in a circle nearly a quarter of a mile across. Inside this outer circle are two others lying nearer to one side. Each of these inner circles is about a hundred yards in diameter; one has a dolmen in its center, the other a single standing stone. All of the stones in this great group are in their natural form, untouched by the chisel.

In some respects more remarkable than Avebury is Stonehenge, which lies about twenty miles south of the former and in the same county of Wilts. It is clearly of later and higher development than its large companion.

A circular rampart of earth, about three hundred feet in diameter encloses within it a circle of upright stones, probably originally thirty in number. The Avebury stones were, all of them, natural. These of Stonehenge are roughly squared and are about twenty feet high. In one place four of the uprights have three lintel stones placed above them. At several other places in the circle are similar caps, making it clear that once a circle of stone ran around the top, each upright serving to support one end of the two stones which reached on either side, to the adjoining pillars. Inside this impressive circle was a horse-shoe of similar uprights with lintels on their tops. All of these are made of the sandstones of the neighborhood. Inside the horse-shoe was a smaller horse-shoe of uprights of stone of a kind not found in the neigh-

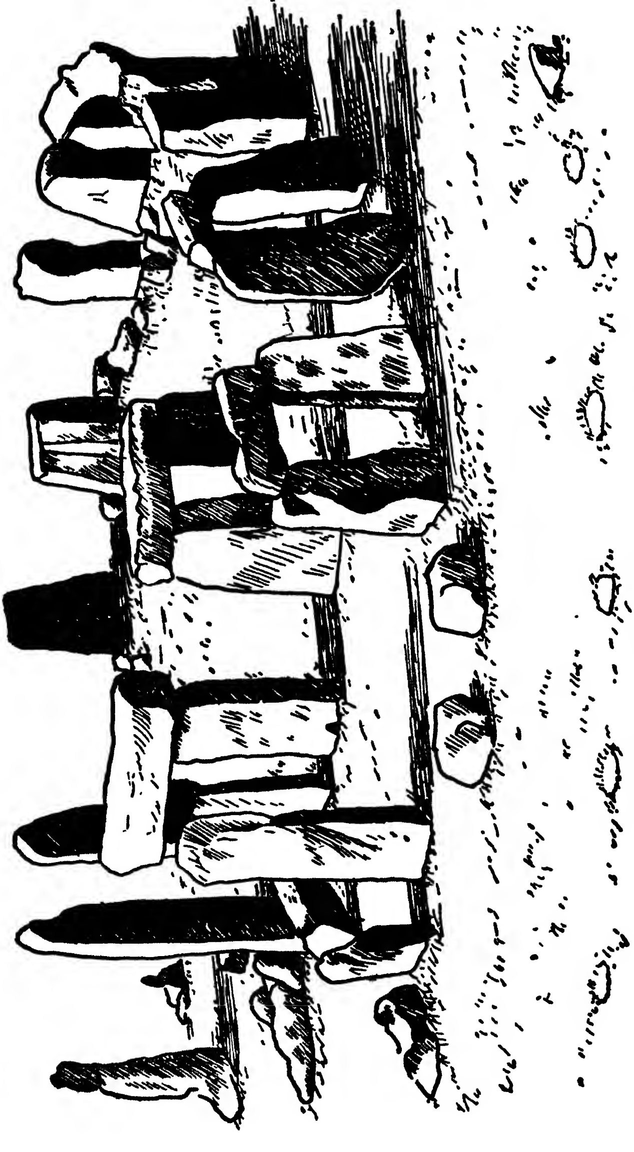


Fig. 57. Stonehenge as It Is To-day.

borhood nor indeed near at hand. Inside the inner horseshoe was a flat stone.

It would seem as if originally a double alinement of stones led up to this cromlech, which is quite the most famous of these megalithic monuments. What did they mean? They seem to close a series of structures which began with the dolmens. These latter were certainly burial places. Many small cromlechs are also clearly burial places, for the skeletons are found there in abundance.

Some students have calculated carefully the angles of the stones to each other, and to the horizon, and have made out that at that time the points of rising and setting of the sun at the beginning of each of the seasons could readily be determined from these imposing structures. To others the alinement was a stately avenue, rich in historic suggestion, up which the people marched, and then went in procession about the cromlech, inside of which in a special enclosure, was the holy place, entered only by the priests. Still others believe these huge monuments were thrown up by soldiers and their prisoners on the field of a great victory. Some of our best authorities believe none of these clearly explain the presence of the strange megaliths.

It seems pathetic that these early folks should have undergone what must have been to them stupendous effort in order that the world might always carry in memory some of their powerful leaders or stirring fortunes or misfortunes. Meanwhile they lacked the power to write on these monuments anything which would enlighten succeeding generations.

The Egyptians by this time were also making great piles of stones over their dead and erecting temples for

their worship. But they had evolved a written language, which they used abundantly everywhere. While this language remained long a mystery, once the key was found, men learned to decipher it. Now it is easy for the Egyptologist to read the history of the past and, allowing for the boastings and the flattery of the great, to decipher the story of that distant time.

The people of Brittany and of Britain had not gotten so far. Few of the megaliths have any markings whatever, and none of them what could be called a connected inscription. They depended on tradition to keep green their history. New tribes have come and swept away the old and the people of to-day look in astonishment at the great monuments. We have a reasonable idea who made them, a fair estimate of when it was done, and little more than a guess why.

CHAPTER XIII

The Lake Dwellers

The first discoveries. The villages and their plan. The houses and their arrangement. Their food. Their implements. Their industries. The reason for the plan. Extensions of the idea.

The lake dwellers were amongst the first of the earlier peoples whose work attracted attention, and they remain today the people whose daily life is best understood. Even the minutiæ of their lives stand revealed by the remains which are brought up from under the water. For fifty years that picture has been reasonably complete. No other prehistoric peoples, at least none without inscriptions are so well understood.

The years of 1853 and 1854 were seasons of unusual drought in Central Europe. The rivers and springs ran low, and naturally the level of the water in the lakes went down with them. This was particularly true of the lakes of Switzerland.

One of the small lakes near Zurich, in lowering its surface exposed, in a sort of bay, a long stretch of muddy, peaty, black bottom. Out of this, stuck quite a number of old piles, trunks of trees driven into the bottom of the lake. When the land was exposed in this way a man who lived on the shores of the lake determined to reclaim

a part of the bed, by putting a dyke of ground about it and filling it in from the mud outside the dyke. In connection with this digging he came across stone and staghorn implements which attracted much attention. He carried them to the meetings of a society in Zurich and a hunt for traces of these people began which has yielded, in the years that have followed, a most rich return.

It soon became evident that there were many places about the lakes of Central Europe, each of which had been the site of a village of these earlier peoples who had made their homes on platforms out in the lakes. Switzerland was particularly rich in such sites, but there were many in northern Italy and not a few in Austria-Hungary and south Germany. One of the Swiss lakes has fifty village sites about it and quite a number of them have more than twenty.

Glacial lakes, and those in this region are practically all glacial, are likely to slowly become converted into peat bogs, and eventually into moors. Such a moor, the bed of an old lake, has surrendered us one of the finest of these village sites.

This locality is known as Robenhausen, and from its preservative peat have been dug very many implements, which range all the way from purely stone and staghorn, to after a while, copper, then bronze and finally a few of iron.

All of these succeed each other quietly and gradually. The new tools came through travelling merchants, and were slowly added. They were not imported by a conquering tribe and imposed on a subjugated people. Ferdinand Keller, whose "Lake Dwellings of Switzerland" is the treasury of information on this subject, thinks these

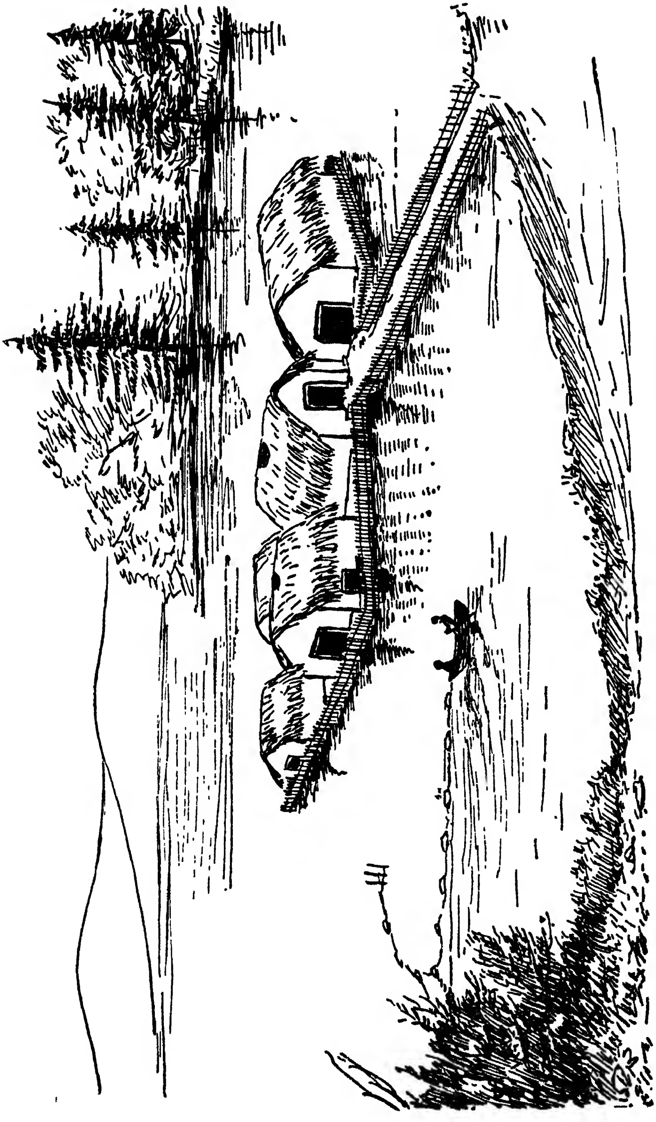


Fig. 58. A Lake Village, after Keller.

settlements were at least two thousand years old and may have lasted twice that long.

Most of this description is based on the Robenhausen finds as reported by Keller.

The village was supported on piles or stakes, at first of softer woods, like fir, later of oak and birch. These were sometimes pointed by fire, sometimes roughly hewn to a point with axes of stone, and towards the last, of the smoother cutting bronze. Often a trunk made a single pile, from four to six inches in diameter. Larger trees were spilt to make more than a single stake. These were driven into the bottom of the lake and their heads cut off even with each other. Sometimes, when the bottom was too soft to give a firm hold, these stakes rested on beams of wood at the base. When the lake floor was too stony to admit the piles, stones were heaped about their bottoms to keep them in place. The top of the post was sometimes notched to receive the stringers, sometimes the latter were fastened to the uprights by wooden pins.

Over this framework, poles were laid, or split trunks with the flat side up, or later even split boards from two to three inches thick. This floor was covered with clay, well pounded down to make it compact.

A bridge of similar character and sometimes of as much as thirty feet or even more in width, and a hundred yards or more in length connected the village platform with the shore. Now and then there was a lake dweller's village that had no bridge to the shore and all communication must have been by boat, or by swimming.

In the remains of the Robenhausen village there are three quite distinct levels of implements and of piles showing that three times the site had been occupied and

three times abandoned. The reason for the first two abandonments is plain. The charred upper ends of the piles tell all too plainly the story of the conflagrations that twice interrupted the history of the settlement.

Along the canal, on the platform of the last settlement, there were clearly six homes, for in the ruins on the

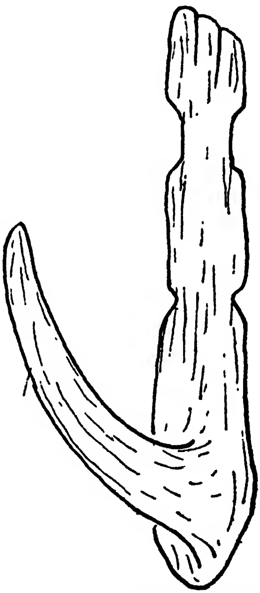


FIG. 59. A WALL HOOK, AFTER KELLER.

bottom of the lake in this section are six grinding stones on which the grain was made into flour by the women of the family.

Early Neolithic houses were largely circular but these are all rectangular. The main upright posts were driven into the lake bottom and allowed to project above the level of the platform, and up to the height of the house.

The rest of the wall was supported by these main posts. A baseboard ran all about the bottom. The walls were filled in with woven twigs and clay plastered over this. These better Robenhausen homes were about twenty-seven feet long and twenty-two wide, which is unusually large for this time. A clay floor covered much of the bottom of the house, a wooden raised platform served for

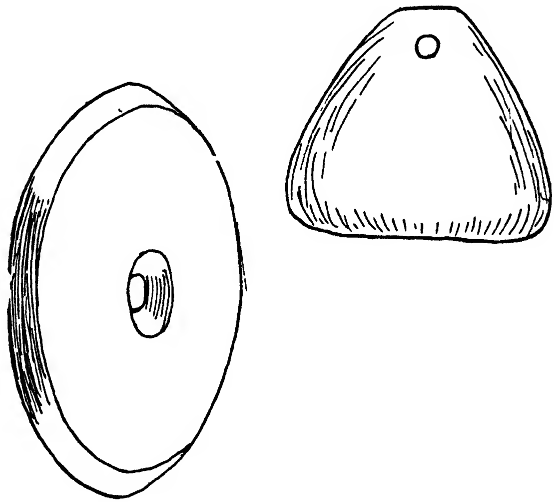


FIG. 60. SPINDLE WHORL AND LOOM WEIGHT.

sitting and sleeping, the beds consisting of the tips of boughs, largely evergreens. A few flat stones marked the site of the hearth. Against the wall were fastened hooks made from a part of a tree with its adherent branch, and from these hung the utensils and the extra clothing.

In the larger and better homes were looms. Two upright beams had a cross piece at the top. From this hung

all the warp strings each kept taut by a clay weight fastened to its lower end. The alternate threads, in common weaving, were attached by cord loops to one of the two heddle sticks. By pulling one heddle forward the first, third, fifth and so forth, threads were drawn

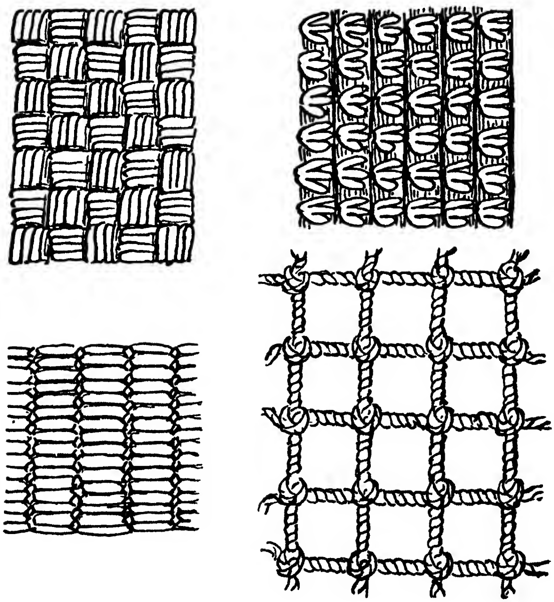


FIG. 61. TYPES OF WEAVING OF LAKE DWELLERS, AFTER KELLER.

forward. The woof thread, wound on a sort of shuttle, was pushed through, and beaten upwards firmly with a long slender stick. Then the other heddle stick was pulled forward and the shuttle passed under the second, fourth and sixth threads, and the woof thread was beaten up tight. Apparently the length of the piece of woven goods was determined by the height of the uprights.

They do not seem to have rolled the piece up and gone on.

It was only in the simplest and commonest weaving that the heddles were always two and always tied to alternate threads. But there are at least half a dozen woven patterns in the linen cloth found in the lakes; so other heddle numbers and arrangements of loops were used by the more skillful weavers.

The thread found is always flax fibre, which makes linen cloth. It is most likely they wove wool also, but it was too perishable under water to remain. The thread was made by having a big bunch of flax wrapped on a stick, held against the body with the flax at the height of the head. The thread as it was twisted was wrapped on a spindle or short stick of wood stuck through a hole in the center of a clay or stone, circular spindle whorl. This weight gave the spindle momentum and kept it twirling for some time when once started. This twisted a few feet of the fibres into a thread, which was then wrapped on the spindle. A little more flax was pulled out, the spindle given a twirl, and a few feet were added to the thread and wrapped up on the spindle as before.

They made ropes as heavy as clothes line. They made cord for the nets. They made thread of varying fineness for weaving into cloth, nicely and evenly done, and often quite thin and firm. The homespun linen of the Southern Allegheny mountaineers is no smoother and more even than that of some of the Lake Dwellers.

Between the houses in the row along the canal were the enclosures in which the domestic animals were penned.

It is clear from the evidences dug up from the lake

bottom that they kept here cows, pigs, sheep, and goats, in the later days of the settlement.

There is an interesting difference between the three successive villages that occupied this site. In the first the bones of the animals used for food are all those of wild animals. Apparently an interval elapsed during which the site was unoccupied between the time of the first village and that of the second. During the second occupancy the bones of domestic and of wild animals seem about equally abundant. By the time of the third village, wild animal bones are no longer found. All the meat used was evidently that of their cattle.

There are races of cattle, as well as races of people. It seems as if at least some of these cattle were not domesticated forms of those running wild in the neighborhood. They came from Western Asia, and were brought in. This is quite as true, or even more true of the grains. Domestication of cattle and planting of grains was taught the European people by new swarms from the old hive in the east.

It is interesting that while the bones of ducks, geese, and swans, which are wild and which naturally stopped on the lake in the migrating season, are quite abundant, the jungle fowl of the Burmese district has not yet come in—there are no chickens.

They made bread, apparently without yeast or other leaven, for the baked fragments are very solid. They made it of wheat, or of barley. Rye is unknown to them, but it looks as if they sprinkled the bread with seeds, as the people of mid-Europe still do. At least we find poppy and caraway seeds in the Lake amongst the debris of the settlement.

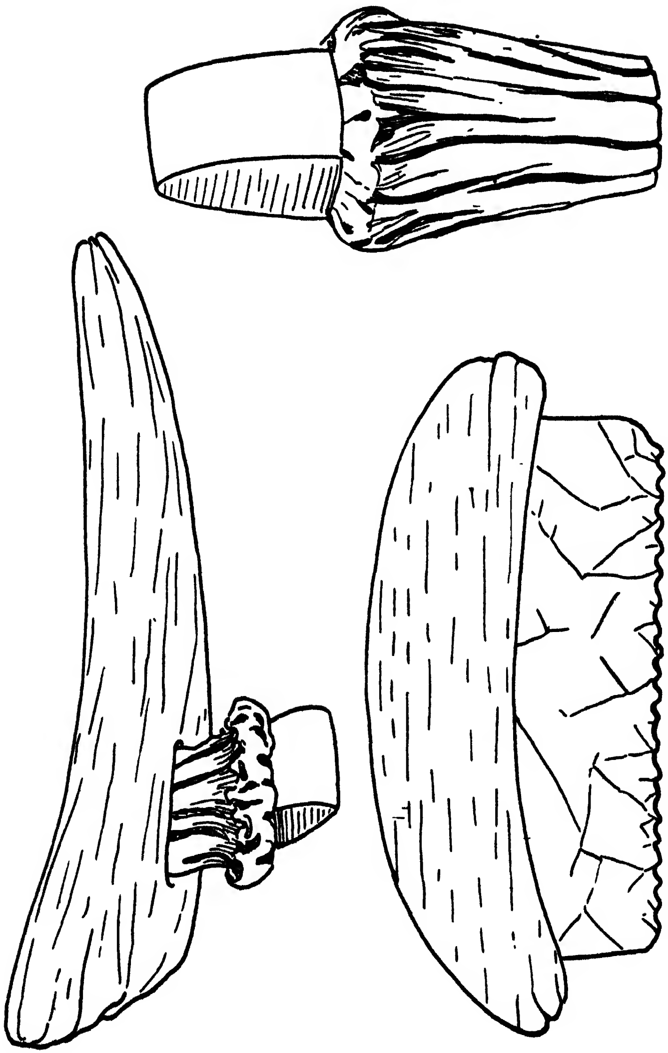


Fig. 62. Axe, Saw and Chisel from Lake Dwellings, after Keller.

They knew quite a few fruits, some of them probably cultivated. While they had an abundance of the small wild crab apples, there were also larger ones which doubtless owed their increase in size to man's fostering care. They knew also both the larger and the smaller types of cherries. An occasional pear is also found. The apples and pears were cut into sections and dried for the winter—a custom which remains amongst the Pennsylvania Germans, who came from that neighborhood, and whose "schnitz" thus have an elongated ancestry of extreme respectability.

Of the berries, which they also dried, we find raspberries and blackberries abundantly, though few strawberries. The elderberry was also well known to them.

Amongst their implements for wood working, we find axes, saws, and chisels which are quite effective. Their axe, especially in the late colonies, no longer has the entire head of stone. It is made of a comparatively small blade of flint, sunken in staghorn, and this pocketed in the side of a heavy club.

The chisel is similarly made of flint sunk into the end of a piece of staghorn. The saw has a long notched blade of flint with its opposite side set into a wooden handle.

In some cases the blade is cemented into the handle by means of asphalt.

With these tools they could do very effective wood work, besides the heavier task of building their villages. Tubs and ladles were hollowed out of maple wood and fashioned with no inconsiderable degree of symmetry. Wooden combs, with reasonably fine teeth show they had grown attentive to the toilet, while their care for dress

is seen in the presence now of pins of bone, as well as needles. They were what we should now call shawl pins.

We find also the boat by which they reached their settlements when there was no causeway, and by the use of which they spread their nets. Pieces of these, knotted with great regularity, we still find. We also find the floats which held the upper edge of the net to the surface and sinkers which kept down the lower side of the net. They had good bone fish hooks, and before the end, still

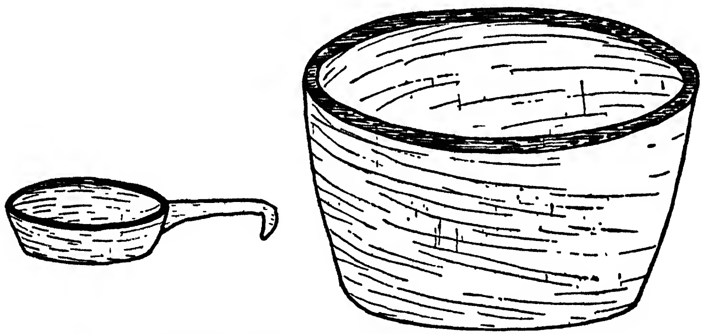


FIG. 63. MAPLE WOOD TUB AND LADLE, AFTER KELLER.

better of bronze. The abundance of backbones found indicate that fish made a considerable part of their daily fare.

The boat of the lakes was a canoe, or rather a dugout, made in one piece out of the hollowed trunk of a tree. One of the boats found was more than forty feet long and four feet and a half wide, and must have represented a very large amount of labor.

No inconsiderable part of our knowledge of Neolithic pottery comes from the lakes. It had not progressed very far—was nothing to compare with what at nearly

the same time was being done in Crete or, better still, in Egypt.

Slowly into the settlements came a few foreign articles of metal brought in by the travelling merchants. They never came in such quantity as to supersede the old materials, and until the dwellings were finally abandoned, they were still in the stone age in general methods of living.

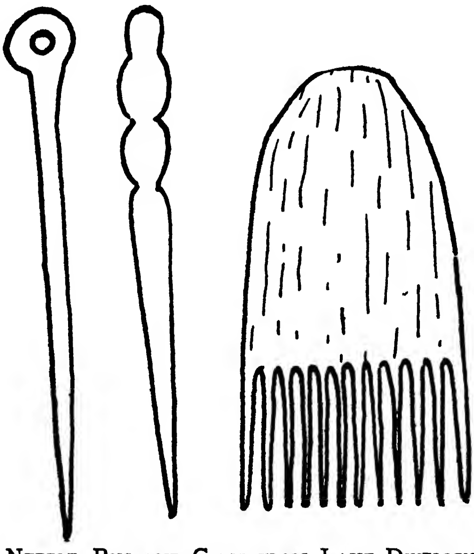


Fig. 64. Needle, Pin and Comb from Lake Dwellings, after Keller.

Beads of carved amber, and later even of jade, were brought in, but they were probably always foreign novelties, owned with much pride by the selected few.

An interesting expansion of the idea of living out in the water to protect the village from too easy approach of their enemies, passed down from the lakes into the valley of the Po. The people there learned to live in the

marshes, in houses built on piles. The remains of such settlements prove to be very abundant in that neighborhood. Such spots are called Terremare, and have yielded many prehistoric implements. It was doubtless such a swamp village that formed the original settlement on the site of what is now the modern city of Venice.

CHAPTER XIV

A Glance Around

European people and culture are all from outside. Not from Greece and Rome. Crete shows an earlier civilization. Egypt shows the greatest advance of antiquity. The Euphrates valley runs farther back. The plain of Turkestan goes still farther. Did progress begin east of this? Or come from the basin of the Mediterranean?

I

We have been following up through about half a million years the development of man, as we see him in Europe. We looked at the beginning of that time at a problematical creature who left his skull cap and thigh bone in the Java rocks. Then we jumped half the time from then to now and landed on a jaw in the sands of a German pit, the oldest truly human specimen yet found. Another jump of half the remaining time brought us to Piltdown man, with his truly human brain-case and his chinless jaw. Our next glimpse is of Neanderthal man, the first man we really know; a slouching, slant headed, heavy browed creature and yet surely man. He holds the stage for the better part of a hundred thousand years and comes down to within twenty-five thousand years of our time. Then he gives way to Cro-Magnon, a modern

type, with tall and erect form, with high forehead, and, best of all, with artistic impulses of a high order. He lives to within ten thousand years of the Christian era when he is replaced by Neolithic men, of his own general kind, but of the type of the Mediterranean peoples of to-day. Soon the land is shared with the Nordics, and last of all in come the Alpines.

When we come to the men of the Neolithic times we can readily feel that there is close kinship with ourselves. Their homes are humble, it is true. But it is not so long since our own ancestors lived in log cabins but that most of us have seen one or two still standing. The loom seems a simple machine beside the Jacquard we have seen weaving its marvelous patterned silks. But most of us have seen the rag carpet loom which is not a very great advance over that of Neolithic times. We have oriental rugs on our floors of marvelous beauty that have been woven on looms almost as primitive, and perhaps Indian blankets on the couch made on looms no better than those of the Robenhausen lake dwellings.

II

The picture we have drawn thus far is of western Europe. Over much of that time northern and northeastern Europe has been covered with great ice sheets so often as to have kept man out of them, up to the time of Neolithic man. North America was probably not entered by man before the time that Neolithic man came into Europe, and when Columbus saw him he was, over most of the country, still entirely in his only moderately developed Neolithic stage. In a few subtropical spots he had

flowered into a remarkable civilization but it is indigenous. He evolved it for himself. While his mind was enough like that of man everywhere to bring about a certain underlying similarity of forms, the things he made had too much individuality to have been copied—at least so most American anthropologists seem to think.

It will be remembered, however, that when Cro-Magnon man appears, while it is not quite suddenly, it is with little transition. He arrived, more or less gradually, perhaps, but he arrived, not developed on the spot. When Neolithic man comes, he really comes, he is an outsider who, not suddenly conquers, but slowly pushes in, with new habits and new implements, with grains and with cattle. After a while fair-haired Nordics share Europe with him and first build the middens and then build the ships that make them the wolves of the northern shores.

Last of all, the round-headed Alpine comes in bringing with him his bronze weapons which are so big an improvement that their use spreads quite rapidly.

These people—the Mediterranean, the Nordic, and the Alpine—are the people whose blood runs in our veins. With all the travel in the world now, there are few of us who do not show in our faces and in the build of our bodies the traces of each of these three sub-races of white people. These are the Neolithic people we have been studying. They come into western Europe bringing their accomplishments and their acquisitions with them.

It is clear then that somewhere in the world must be peoples who developed faster, in spots doubtless more favorable for those stages, than western Europe.

While the Lake Dwellers are catching their fish, and milking their little cows, and rubbing their wheat into

rough meal, and weaving their coarse nets, what is the rest of the world doing? Where are the favored peoples who are blossoming into a civilization with which we are to be infected later?

If we think of the Neolithic time as giving place to the age of metals two thousand years before Christ, it is useless to look for leadership to Greece or Rome. Greece dates the beginnings of her own history from her first great national games, her first Olympiad, which took place in 776 B. C. Her people, two thousand years before the Christian era, were utterly barbarous tribes, little farther advanced, if any, than the folks we have been studying. Her lessons are all yet to be learned from others.

Rome is no better off. She dates her beginnings A. U. C., anno urbis conditae, from the year of the founding of the city, which by our chronology was 753 B. C. Rome is little if any better off than the countries now called France, and Spain and England, which we have been studying.

But the Greek type of civilization is growing up, and not very far away, on the island of Crete, was the city of Knossus. Here lived the fabled King Minos, who kept the Minotaur which ate Greek maidens and youths sent as tribute. From this story the civilization is known as Minoan.

There is a strange similarity in the history of this city and of Robenhausen. Each is known only by ruins that long lay unsuspected. Each when worked over proved to be made up of three cities on top of each other. In each case the two earlier cities had been destroyed by fire. But while Robenhausen was built on wood piles, with

houses of wattled walls, daubed with clay and smeared industriously and ambitiously with zigzag lines of color, the great palace of Knossus was built of majestic masonry, with a paved street approaching it. It had many large rooms, and subterranean chambers, for storage of food. Great jars, as high as men, held oil, or grain. A stately stone chair seated the King in his audience chamber, while stone benches, lower down served his courtiers. The palace was also the temple and the king the priest—high priest. Beside his courtroom was a bathroom, doubtless for ceremonial washings, and in another part of the palace a much larger bathroom for the general bathing of the household. Some of this came later than 2000 B. C., but all of it came, and went, while Robenhausen still stood.

Earlier than this, the Minoans had devised for themselves a written language, which still awaits its decipherer. It is not closely like any of the great written languages of antiquity, for these men have come to read quite readily.

These people of Knossus were learning to make most beautiful swords from bronze, to paint their walls with remarkable pictures often depicting sports. A wonderfully lifelike fresco represents a fight between several men and women against a bull. One of them, whose hands have tight hold of the bull's horns, is being thrown over the creature's head. But it is quite evident the trip is not unexpected, and is a usual part of the game from which the fighter expects to escape unhurt. A strange dress fashion is apparent on these people. They wore metal bands about their waists, reducing them at that point to a narrowness that must have been the result of long binding or it would have been excruciatingly painful.

When we come to examine carefully the Minoan pottery and architecture we see that it bears traces of an outside influence.

Is there an older civilization near by? The oldest civilization known to the early historians was not so far away but that men traveled to and fro between them, bearing goods both ways. In the valley of the Nile is the great civilization of early times. History here seems to be full and accurate further back than anywhere else. Here civilization certainly came to rich blossom earliest, and reached its highest point long before Greece gave the world its most dignified architecture, its most marvelous representations of the human figure, and, with the exception of the religious literature of the Hebrews, the most exalted writings the world had produced.

At 2000 B. C. much time must still elapse in Greece before all this is to come to pass. But Egypt fourteen hundred years before had started her first dynasty's ruling over the earliest great united people of the world. By 2000 B. C. the enormous pyramid and its sphinx were fifteen hundred years old. And all of that time Egyptians had been writing, by inscriptions, the history we have learned to read. Every tomb, almost every wall tells a story, often flattering and boastful, but one from which it is easy to learn the truth.

When Knossus was to go down for the last time and while Robenhausen still had a long time to run, King Tutankhamen was to be buried in a splendor whose magnificence startles us today. Gold is to be lavished on his chariot, his bed, his trappings, everywhere. Garments are crusted with it. Necklaces, belts, pins, sandals are to be marvelously decorated with it. Covering after cover-

ing of linen, of wood, and of stone are to shroud him in. And all is to be blown over with sand and buried for thirty-three hundred years. When uncovered it shows to us modern people that no man stands to-day high enough in the regard of his fellows to have them bury him like that. Neither does any man to-day dare to hold himself of so much account as to provide, no matter what his wealth, for so sumptuous a burial.

It is clear, civilization blossomed in Egypt with a luxuriousness that is marvelous. Men here grew to a mighty stature. They went out to conquer or remained home to build. From them went out an influence that underlies Greece, which underlies Rome, which underlies the modern world. It is not strange that men who have given themselves up to the study of this astonishing culture should see in this strange valley the birthplace of all civilization.

III

But to this not all men will agree. There is another alluvial plain that developed with Egypt. It never blossomed quite so magnificently, though its monuments are also colossal and stately and are covered with inscriptions.

Babylon, Assyria, Chaldea, are to succeed each other, and all to be powerful. Their history is to be written on little bricks of clay in triangular dents, that seem fleeting but that have proved wonderfully durable. The civilization of this country has nearly disappeared. It never reached as high a stage as that of Egypt. But when we trace it back it is older than that of the Nile valley. Egypt may have learned its first lesson from the early

settlers along the Tigris and Euphrates, or both of them may have gathered the beginnings of their culture elsewhere. Where may we look?

If the home of the race is in the highlands of Asia, if out of these highlands have come waves that have peopled the continents one after the other, and repeopled, and again repeopled them, then we must look farther east than the Euphrates for our beginnings. Have we any trace of such an earlier civilization?

Yes—a trace surely. Mr. Raphael Pumpelly has been working with the spade even farther east. Originally a geographer and student of climate his studies on the plains of Turkestan converted him into an archaeologist and he went back to uncover with the spade the longest stretch of history that has ever yielded to human search.

On the high plains of Turkestan the climate is so dry and the region so barren that only the watered spots, the oases, can support any considerable collection of people.

The dwellers in this neighborhood make their homes of sun-baked bricks. These gradually crumble, and other houses are built upon their ruins. Again and again the spade has shown a mound in an oriental country to be such a site of a city and has dug the history out of the mound.

Where the story runs parallel with that of neighboring and better known regions it is often possible to date with considerable accuracy the different layers, as was noticed in an earlier chapter. When, as in Turkestan, the region is out of the line of regular commerce, and little influence of better known countries can be traced, it becomes very difficult to run the story back very far with any exactness.

Pumpelly had little difficulty with the later part of the

history. This was quite sufficiently connected with the outside to make dates possible. He found that during this clearly dated time the debris built up the general level of the site at the rate of two feet a century. Fortunately for him there were three such mounds together. Most diggers have called these by the Latin name of tumulus. He uses the native name of Kurgan. There is a North Kurgan, a South Kurgan and an abandoned city, Anau, also on a Kurgan. The North Kurgan proves to hold the simplest remains and to be quite the oldest. It partly overlaps the South Kurgan which runs along until it is deserted and there is a gap—apparently short. Then Anau is founded on the third and lasts until the middle of the last century. The marvel about this culture is not its quality. In this respect it is not remarkable. But if Pumpelly is anywhere near the truth in his estimates of time here is a continuous history that takes one's breath. Let us run back through his summary.

Anau was abandoned in 1850. Its history is easily connected with the outside and it runs back to 370 A. D.

There seems to be an interval of one hundred and seventy years between the earliest life in Anau and the latest on the southern mound whose summit Pumpelly sets at 200 A. D.

This mound runs the story back to 5200 B. C. From 2200 B. C. back, the north mound also is inhabited and the cultures of the two mounds run parallel for three thousand years. This runs back of the use of iron, which is not abundant here, and runs also through the copper period. If Pumpelly is right, the Neolithic ended here three thousand years earlier than in Europe and perhaps a thousand years earlier than in Egypt.

The North Kurgan runs the story much farther back. There seem to have been domesticated animals here, sheep, goats, cattle running back to a date which Pumpelly sets for the base of this mound at 8200 B. C.

Of course he does not claim accuracy for these dates. Equally, of course, he is not imposing mere guesses on his readers. This is the sober work of a scholar, working in conjunction with other scholars, and considered worthy of publication by the Carnegie Foundation in their series of scientific researches.

Pumpelly does not think he has the seat of early man. He believes that it is still further east and that the Anau diggings are not down to the bottom. Ellsworth Huntington, who explored this region with Pumpelly, suggests that just as alternations of glacial and interglacial conditions over Europe and Asia were the fertile agencies in stimulating the physical evolution of early man, so the alternations of desert and fertile conditions on the Asiatic plateau similarly did much to stimulate the development of his civilization.

There is still another speculation as to the home of early civilization. This is quite the most picturesque and is the safest to make because its truth or falsity is very difficult if not impossible of proof.

It has been mentioned that there have been frequent periods in glacial history when there were land bridges across the Mediterranean Sea. There was a bridge at Gibraltar and one from Italy across to Africa. It is also true that even to-day the Mediterranean receives more water from the Atlantic than it gives to it, in consequence of the dry winds from neighboring desert steppes. In other words, more water evaporates from the Mediter-

ranean than is poured into it from the rivers and the balance must come in from the ocean. The result is the Mediterranean is more salty than the Atlantic. Hence if we were to cut off the connection with the ocean this sea would slowly evaporate until it became two lakes much lower than the level of the ocean, like the Caspian, the Aral, and much more strikingly, the Dead Sea. The Adriatic sea would be a valley with a river in its depths and the Ægean would be a plain covered with mountain knobs.

The suggestion is that in the eastward of the two-basins civilization had its fostering conditions and there it really began. There too it developed until the sinking of the land and the rising of the ocean level due to the melting of the ice cap made a gap at Gilbraltar. After this the western lake filled up first and then the eastern. The filling up of the basin, especially the second, must have been comparatively slow. The peoples of the great valley had to vacate. Some went up the Nile. Some climbed the big mountain whose top is now the island of Crete. Others still went up the Syrian shore and settled in the Euphrates basin. The picture is a fascinating one, with just enough possibility to make it worth considering.

CHAPTER XV

Man To-day

Primitive man is now lost. The characteristics of race. The yellow race and its derivatives. The black race and the tropics. Mixture of yellow and black. Whites of the European section. Their three divisions.

I

There is no group of men in the world to-day who could be pointed out as the normal type of human beings from whom the rest have slowly separated. There is general agreement amongst anthropologists that all the present inhabitants of the earth are of the single species, Homo sapiens. Certainly intermarriage between any of the races is very common and their children are not infertile hybrids.

Dr. Stratz of The Hague pictures a quite comely girl from Mexico, whose father was Chinese and whose mother was the child of a Creole (white) and a Sambo (mixed Indian and Negro). Thus within three generations back of the girl are white, yellow, black and American Indian.

Fertility of hybrids used to be considered an unfailing test of species. While this is no longer accepted as correct, the abundant and easy intermixture of any, or in the

case of Stratz's example, of all the races is very strong evidence that all the present inhabitants of the earth form but a single species.

This again makes it difficult to give any single definite character which will distinguish one race from another. Color will not do it, though this is what has come to be the distinction in the common mind and in ordinary language. It was well enough in the geographies of our childhood to speak of white, yellow, red, brown, and black races. I suppose most of us were later surprised to see an American Indian for the first time and to wonder why they called him a red man. Large parts of Africa are peopled by negroes who are far from black, even without white intermixture of any kind. To hear a high class Hindoo called white seems equally strange. Evidently color is not a sufficient criterion.

The length of head is a favorite character with many students, and certainly holds its own unaltered through generations better than most characters. Hence it is customary to measure the greatest length and greatest breadth of the skull and express the result in the percentage of the length found in the breadth. If the breadth of this head is less than seventy-five per cent of its length, the person is long headed (dolichocephalic). If, on the other hand, the breadth of the skull is more than eighty per cent of its length, the individual is round headed (brachycephalic). Almost all primitive men were long headed. Neanderthal man was distinctly so though a few Krapina skulls showed a broader index; so in Cro-Magnon times nearly all specimens are long headed, but a few entering central Europe from the east are round heads. Only in Neolithic times do we discover any considerable number

of round heads. All of these are probably related to the Alpine element in the European population of to-day.

The typical yellow people are for the most part round heads. The American Indians are in part long heads; in part round. The black race are long heads.

Hence while it is very clear that head form is significant and persistent it does not mark race form.

The character that comes nearest to distinguishing race is the form of the hair. Its color is not nearly so distinctive. If the hair is truly cylindrical, like a round lead pencil, it hangs perfectly straight. People with such hair are said to belong to the straight haired group (Leiotrichi). In this group, while the hair may not be entirely round in section, its shortest diameter is usually eighty per cent or more of the longest.

This kind of hair is found in the yellow race, including both the Asiatic section and the American. People of this sort have the longest hair on their head on the average of all the races. Strange to say, they also have the least general hair over the surface of the skin, including the beard which is quite scanty if not absent. In this group both men and women have about the same length of hair.

In the black race the hair is formed like the carpenter's lead pencil, which is flattened to keep it from rolling. Its section is a very distinct ellipse. The shorter axis may run as low as forty, and rarely runs over sixty per cent of its longest. The greater the flattening, the more this hair curls on itself. The course of the hair under the skin is markedly curved. These people have the shortest hair in the world. Here also both men and women have about the same length of hair. This is spoken of as the wooly haired group. In one section of it, the hair curls very

tightly. People who have this type of hair are called kinky haired (Ulotrichi).

The wavy hair is chiefly associated with the so-called white people, though they are never really white and often very dark. Hair of this sort has the shortest diameter of its section running from sixty-two to seventy-five per cent of its longest. This hair usually starts waving near the head and often gets quite curly before it is very long. People so provided are said to be wavy haired (Cymotrichi). In this group the hair of men is never nearly as long as that of women. In both sexes the hair is not so long as that of the straight haired Mongol or American Indian and is much longer than that of the Negro. These white folks too have much more hair over the body generally than do the much smoother skinned Mongols, the Indians, or the Negroes. This is particularly true of the beards of the men.

The hair then seems to divide men best; but other characters run along with these to make up the general racial type.

II

We begin then with the yellow race as lying nearer the primitive home and embracing the largest numbers. They are not the original stock, for the old stock forms were all long headed and the yellow man is very round headed. He has black hair, and is usually of medium size, his shortness being more in his legs than in his trunk. The skin is yellowish, shows little of the red tinge of blood on the cheeks, and is very smooth and free from hair. The features seem to us flat. The nose is not as high as ours

nor does the bridge sink as deep between the eyes as ours. The lips are quite thin. At the nose end of each eye the upper lid, instead of ending in the upper border of a little tear gulf, as it does with us, overhangs this gulf and runs down over the edge of the lower lid. This forms the so-called Mongolian fold. The race is generally less emotional than either of the other two, and in its extreme forms is stolid. There are a number of sections of this group, most of them in Asia, and several at least in the Americas.

North-central Asia is the home. From this point these folks radiated north, northeast, east, and southeast. The northern section got as far as Lapland. The Northeastern section went on in several waves. They crossed over to America on land bridges in the Alaskan country and probably all came within the last ten or fifteen thousand years. The earliest one was driven by the later arrivals to the southern end of South America. Several more waves made the great groups of South and North Americans. The last of all was undoubtedly the Eskimo.

Dr. Ellsworth Huntington, of Yale University, has an interesting suggestion with regard to the stolidity of the American Indian. This author has had large experience in many parts of the world and has particularly studied climate, its causes and its effects. He speaks of the long winter night of the Arctic, the bitter cold, the unvaried food. All of these are hardships of the most severe sort. Just these physical conditions would weed out weaklings. In addition, the wearisome monotony of the long darkness conduces to a type of insanity in those who are either emotionally unstable or particularly sensitive. There must

have been a long slow march of the American population through the cold north, whither they came by the Behring bridge or by the bridge whose long line of mountain tops now forms the Aleutian and Kurile Islands. This period of northern hardships through which they all must pass, inevitably eliminated all those of sensitive mental make-up and left a remnant of strong, hearty, stoical people.

Every now and then there comes a new student of the old civilizations of tropical America who is struck by the similarity between some of the figures carved on Aztec or Mayan or Incan monuments and those of Egypt and the Mediterranean countries. He finds similar figures in the Polynesian district of the Pacific Islands. This leads to a belief that somehow a Polynesian invasion, by boats across the Pacific, is necessary to account for this similarity.

Students, like Dr. Hrdlicka of the Smithsonian, of the physiological character of these men, and men who like Dr. Wissler, of the American Museum, study the cultures of the continent as a whole, seem now to agree that there is no real basis for the conception, and that all America, previous to the entrance of the European after Columbus, was peopled by a comparatively homogeneous series of peoples derived from the Asiatic continent, and from the yellow race. It is believed they all entered by the Northern route and have all come since the glacial period.

Now and then there have been finds on the pampas of South America, in California, in Florida of the remains of men who were believed by their finders to have long antedated the Glacial. Thus far their discoverers have been unable to persuade the men whom I have mentioned,

or indeed most of their colleagues, either of the antiquity of the location or of the primitive character of the skulls. While the question may still be considered possible to open, its present position is, I think as indicated above.

A section of the primitive yellow peoples went down the long eastward trending river valleys. These two went in successive waves. They have become the Mongolians, Koreans and Chinese. The Japanese belong to the same strain, but with larger admixture of peoples of earlier type who had preceded them and of peoples with whom they came into contact by moving about on the islands.

To the southeast went the tribes who have become the Cambodians, Burmese, Siamese and the Malay peoples. These too have spread over the islands where they came into contact with the island blacks who spread down from India. It is probable this yellow branch was an early shoot that came off from the home stock not far from where the earlier white stock went east. Just as Singapore is the port in all the world where to-day it is possible to see more kinds of people than in any other city, so the islands running out from here have probably the most mixed population in the world.

Dr. Louis R. Sullivan, of the American Museum of Natural History, who has recently studied these people in their islands with much care and with all the appliances for measurement and photography available to the modern anthropologist, thinks that though they show some Caucasic characters, they are the characters common to the strains when both were more primitive rather than that they point to an actual more modern Caucasion infusion. In any event, it is a highly composite group.

III

The black race has many sections and many waves have gone out from the original region of Southern Asia.

The people of this group all have hair which is more or less flattened in section. In some of the earlier ones there is only enough of this to make the hair wavy, but in all the later migrations the hair is quite tightly and crisply curled close to the head. Often it clings in tufts, when it is said to be peppercorn. In this hair the shortest diameter of the section is never more than sixty per cent of the longer and may run as low as forty. The skin varies from a yellowish chocolate to a thorough black. The features of this race are, with the exception of the nose, much more prominent than those of the white race. The nose itself is very wide and much flattened and its bridge is deeply sunken, the eyebrow ridges are heavy, the forehead, in many, bulges forward. The teeth and lower jaw project farther forward than in either of the other races. They are long headed, some of them the longest headed people in the world. Many of them are tall; and their tallness lies chiefly in their legs rather than in the trunk. Their arms too are likely to be longer in proportion than those of the other races. They are more emotional than either of the other types of people.

Africa, like every other region in the world, has been peopled in a series of waves.

There must have been very many of these, all entering by the Nile valley or the Arabia-Abyssinia route, perhaps most of the early waves by the latter which had once been a land bridge.

A very early migration in several waves probably gave

Africa the Hottentots, the Bushmen and the people who, in the depressing environment of the closest and darkest forest in the world, became the Pigmies.

Perhaps the Negroes of the Sudan and Guinea came next. They were followed by the Great Bantu and allied groups that spread over the Eastern part of Africa from Abyssinia to the Cape. Somewhere during this time came the early Mediterranean branch of the white race who were later followed by the more Semitic branch who spread over Egypt and the north shore of Africa. They also pushed up the Nile valley and mingled with the Negroes. Hence the nearer we approach the upper Nile country the more mixed are the people.

It is only proper to repeat here that there are anthropologists who believe that Africa is the primitive home of the race. This side of the argument has just been strengthened by the finding in Bechuana land, by Professor Dart, of a skull which he thinks to be higher than the ape and lower than the Java skull. Thus far it has not been studied. The movements of these earlier races are difficult to follow and we have as yet no sufficient body of facts on which scholars might form a final judgment. The joy of the whole subject, to the eager student, is that it grows day by day.

There is a very interesting suggestion that has come in recent years which would, if true, account very naturally for the deep color of the black race. It is based on a frequent observation of those who have had much to do with large groups of Europeans or Americans transported to the tropics. It seemed to be strongly confirmed by the experience of our American troops in the Philippines. It is that blonds suffer far more from moving

into tropical conditions than do brunettes. We have become familiar with X-rays that penetrate substances which are impervious to rays of ordinary light. The suggestion is that amongst the actinic rays of the sun are some which can penetrate hair and skin and skull and injuriously affect the brain itself. Umbrellas and hats are no more impervious to the rays than the skull and do not provide immunity. But just as a thin coat of lead on a leather apron will protect the operator from the injurious effect of continued exposure to X-rays, so the dark pigment of the human skin is a light screen to these actinic rays. The dark color is of a kind that protects from the fierce onslaughts of a tropical sun. The system protects itself by developing this tan when exposed to light. This effect is not transmitted however. The child born while both father and mother are so tanned temporarily is no more likely to be dark than if the parents had had their previous winter and city bleach. But the long effect is the same. For some reason or other (a reason will be suggested later), some people of any race are darker than others. Expose such a people to the tropical sun and the blonds will slowly and gradually be weeded out, generation by generation, leaving the darker to then continue the fight and to propagate their kind. Such a process long continued would naturally result in the formation of a darker people.

Exactly a similar selection by the sun has favored those, whose hair, by repeated curlings on itself made a thicker and more impervious screen of the dark color than if they had hung straight. So the sun, while it did not make them black and curly, killed off the lighter skinned and straight-haired members of the race.

IV

The white race is probably the last evolved of the three, and also, in most respects, the most modified. It has certainly responded most rapidly to civilization, due not a little to its superior adaptability and to its inventiveness.

In bodily characters it differs from the other races in many ways, and has a very wide variation inside its own numbers. In color it ranges from the blonde Swede, the lightest people in the world to a Berber who may be quite as dark as some of the lighter members of the black race.

The head may be very long indeed, as in many Scotch people or quite round in some of the Alpines. The wavy hair of the north sometimes clings closely to the head in ringlets while the inhabitant of the Balkans may have it quite straight and still be of the white race. In this race the male and the female differ more from each other in hair, in bodily form, and in disposition than either of the others.

There are clearly three very different waves of white folks, who make up the great part of the population of Europe. These differ from each other in many ways.

The first to arrive in Europe are the Mediterraneans. They came along both sides of the sea, and perhaps moved back and forth between Europe and North Africa in earlier times. These people are short of stature, dark of skin and hair and very long-headed. The face is distinctly oval, its lower jaw portion being noticeably narrower than the forehead. The eyes of these people are distinctly snappy. In disposition the race is markedly and joyously artistic, and has given us much of the bril-

liant music, of the beautiful painting, of the noble sculpture of the world.

These people line the Mediterranean to-day, with admixture in the upper end of each peninsula with the Alpines who live above them, and have also a small infusion of fair Nordics who have come, as conquering tribes, at intervals all through their history.

After spreading along the edge of the sea, these people passed up over France and into England. Later incursions of Alpines and Nordics have pushed them west, or intermingled with them. Thus West England, Wales and most of Ireland are peopled with a much darker folk than Eastern England, Scotland, or the extreme north of Ireland, which are prevailingly Nordic.

The Nordics arrived later in Europe. They probably came north of the Caspian and crossed the Russian plain, gaining their distinguishing characters as they came. They seem to have become much what they now are, physically, in the Lithuanian district. They spread over the north of Europe with excursions everywhere. They early learned to conquer and soon learned to sail the seas in such conquest.

They are the Normans of France and England, and the Norsemen of Scandinavia, as well as the Danes who harried the coasts of old brunette England. They found Iceland and apparently North America though they did not stay there. But they came back, and their build is easily seen in the Yankees of New England, the Hoosiers of Indiana and the mountaineers of the south. They are tall and usually slender. They are very long-headed. The face lacks the oval of the long-headed Mediterranean. The jaw is wider and the forehead narrow from side to

side and very high. This makes the sides of the face more nearly parallel than in the Mediterraneans.

Their skin is fair, and burns red. It freckles easily. Their hair is fair, often sandy and not infrequently red; the only really red hair in the human race. Their eyes are blue. They are the venturesome people of the world. Slowly they have spread, in the person of the English people over most of North America and Australia, and South Africa, with a grip on spots here and there over much of the rest of the world. They are the people who gave its character to the United States. The English-speaking peoples of the world are inclined to call themselves Anglo-Saxon, even though they are clearly Alpine in body form, though rather Nordic in coloring, and modesty as to the superiority of their own acquirements is not their strongest character. There is a school of Americans who feel that any deviation from this blood and type must bring destruction. Yet almost any inhabitant of the United States, whose family has been here for more than fifty years, will number amongst his relatives people who are short and stocky and people with dark skin and hair. In other words, some members of any of their families will show the evidence in the blood of all three strains.

The last comer of the three into the European field is the Alpine. He came across the highlands of Armenia and stuck chiefly to the uplands of Europe. Two sections of the Alpine race are evident. In South Germany, Switzerland, North Italy and France is a great body of Alpines who seem to have gained, perhaps from intermixture with the Nordics, some of the Nordic color, but they keep their body form intact. These western Alpines are

taller than the Mediterraneans, and shorter than the Nordics, and their skin ranges in color between the two. Their eyes, when blue are a grayer blue and they are oftener gray or hazel. Their hair is brown. The head is very distinctly round, as is the face. The Eastern section, through the Hungarian and Balkan country, is very much darker of skin, eye and hair, and their hair is straighter than is the case with any other white Europeans.

In addition to these three strains, the southeastern corner of Europe has been the entering point in historic times of Semitic Jews and Arabs and a touch of Mongol in the Turkish and Magyar blood. These with true Mongol in the Lapps complete the varied collection. The Alpine people have had a stolidity which has made them take to agriculture and has made it easier for the Nordic to conquer, and then fuse with them. In North Germany and Russia, the nobility is more likely to be Nordic, and the body of the workers Alpine. In England the same is true of the nobility, but the workers are mostly Mediterranean. Even in England a considerable part of the farming people must be Alpine or we never would have had so Alpine a figure as that of John Bull to stand for the stability of the British nation.

There is a group of people in the United States who are anxious to prevent all admixture of any other blood with the Nordic. The truth is that there is very little pure Nordic blood in the United States except that of some of the Scandinavians of the Northwest. The three strains are hopelessly intermingled. It is certainly true that no country can safely afford to admit any people whose institutions differ radically from their own at a rate faster

than they can be assimilated into the political and social structure. It is certainly true that to admit aliens in great groups, to do the least remunerative work, to make them so unwelcome everywhere that they are compelled to live crowded into pitiful homes for which they pay often as much as far better homes should cost, and then to give them opprobrious nicknames and permit designing men to exploit them, is to nurse a set of sore spots in the body politic.

There is no one of these strains that, properly treated, does not yield valuable returns in citizenship and in progress.

There is no such thing as a melting pot in the strict sense of the word. Characters do not blend, if the modern student of heredity is right. But the effect is just the same for all practical purposes. Man is made up of a host of "unit characters" which build him like a mosaic. Each of these units goes into inheritance practically independently of each other character. Each of the sex cells of two parents uniting to produce a child will throw out half its characters and the offspring will owe half its units to each parental line. Such an unit, thrown out from the combination, has disappeared from the descendants of that individual forever unless brought into the family by mating with an individual who has it.

Hence it is possible for breeders, given sufficient time, to make practically any combination of the characters of two strains of domestic animals, or even of more than two. I have seen a ladyslipper orchid (Cypripedium) which had been produced by hand fertilization of two strains each of which had itself come from two other

strains. This flower showed some of the characters of each of the four species that had gone to its making.

No one with any knowledge of science or sense of decency expects to mate people selectively for the production of proper offspring. What we need is ideals and character, and in time the offspring will correspond to the ideal. It was so each of these races was built up and kept true to type.

If we can have an openness of mind, a clearness of ideal and a resoluteness of character which will make conduct correspond with ideal there may some time arise a new and characteristic American type of which we shall be proud.

If we can gain the stature and the venturesome character of the Nordic and lose his haughtiness, gain the rugged health and sturdy persistance of the Alpine and lose his stolidity, gain the vivacity and the artistry of the Mediterranean and lose his variableness, we shall have the finest people the world has yet seen.

How did the white people get white? Why did the Nordic become the lightest of all? Not simply by going north, for the Eskimo has gone farther and still is swarthy.

Just because the penetrating effect of the actinic rays of the sun weed out blonds, as a people migrates slowly into the torrid zone, so the lessened power and greater obliquity of the rays make it safer for, but would not compel, a northern people to grow light. But what led them into blondness? Here we fall back on a much overestimated, and yet, especially in higher animals, a very effective force, sexual selection. Should there arise in a northern people a greater admiration for the fairer members of the group, this in itself would lead to what we call

preferential mating. The fairest members would be chosen first, and would fall to the most vigorous suitors. This in time, in the absence of any deleterious quality in the character chosen, would make the average of the people lighter. It could not happen in the tropics because the blondness would in the long run be fatal. It could, in more northern climes, and is increasingly possible as we get away from great heat. Perhaps this is fanciful. Let it stand until there is a better explanation or an insuperable objection.

V

Biologists will generally agree that all of the suggestions thus far made as to causes of the differences between races have shown the conditions which would have favored the selection of the qualities when they tended to arise. But what made them arise? This is the field of biology to-day. Darwin found the variations and accepted them, though he too said they could not be accidental.

An interesting suggestion is being made by the students of the endocrine glands. It has been previously mentioned that there are glands in the body which take in blood, take from it constituents they need, and recombine them into a very small amount of a chemical compound entirely peculiar to that particular gland. These substances, called hormones, chemical messengers, are carried over by the blood to all parts of the body there to stimulate peculiarities of growth and development. One of the best known anthropologists who has embraced this idea is Dr. Arthur Keith, of the English College of Surgeons, and a man of high standing in his science.

In his address as President of the Anthropological Sec-

tion of the British Association for the Advancement of Science in 1819 he summarized what seemed to him the direction in which discoveries in that field are leading.

He believes the man of the white race owes his strong nose and eye ridges, his prominent chin, his bulk and his height to the unusual quantity of secretion poured out by his pituitary gland. The stronger differentiation between the two sexes than falls to those of other races, he owes to the interstitial cells in the sex glands. The fairness of his skin he owes to his adrenals.

The yellow race, he thinks, owes its marked character to excessive secretion of the thyroid gland.

The black man owes the darker pigment of his skin to the comparative inactivity of his adrenal glands.

But this, after all, only throws the process one step farther back. The big question still is why do fit characters arise? We see how they are preserved, but not why they come.

It is taken for granted by a great many observers that a mixture of any two of the three great races produces a hybrid with the bad qualitites of both and the good of neither. There are others who think that matter far from settled. There can be no question that hybrids of the dregs of each race are inferior, and it is the dregs usually that mix. It is equally true that while social ostracism and political inferiority await the progeny of the union, the result will always be pitiful. The instinct to mate with one's kind is millions of years old, and may never pass away. As a scientific problem I think most biologists are agreed that the question is quite open whether mixed races, in the absence of social and political stigma, are not entirely the equal of so-called pure races. It will be ages

before there will be any larger intermingling of races. We believe religiously in the brotherhood of man; but practically we are far from accepting it as true.

With the rapid means of communication now at our disposal, with men going to and fro in thousands over the world, it may be that in long time to come men shall be brothers in each others' eyes even as we believe they are in the love of a Heavenly Father.

CHAPTER XVI

Man's Body a Witness

Vestiges of organs, once more useful, remain. The upright position is still a difficulty. The developing embryo and the new born child tell a story. Man's evolution is now ethical and social.

I

In any organization there are always evidences of history outgrown. To go into an American court room and hear the court crier call "oyez" at the opening of the session points to the fact that we got our courts from England and that the Normans invaded England long ago and, these conquerors holding power over the courts, their language was the official language for the transaction of such business.

When a man is found dead, or dies from a cause for which some one else may be at fault, we summon an officer to examine into the matter and to place the blame. This officer we call the coroner because once all of us belonged to the crown (corona) and the king must be satisfied, in the person of his representative. The call of "oyez" and the name "coroner" are vestiges.

When we give small amounts of money for indefinite charitable purposes we are apt to call them alms. Why

is there an l in this word? We do not sound it, but we still write it? We learned our alms-giving from the church. In the Greek language of the early church, such contributions were eleemosyne. Perhaps they thought more of it and gave larger sums then. We still give imposing names to bequests and legacies and subscriptions. But our small givings have a shortened name. Eleemosyne has become alms. In speaking, we have gone farther than in writing. We have dropped the l from the sound but it still remains as a vestige of the earlier form when we write the word.

The back of a man's frock coat has on it two buttons. They serve no purpose whatever. Custom alone puts them there. But how did they get there? The frock coat is a gentleman's coat. The sack coat is the coat of the workman. In the early days it was the prerogative of a gentleman to wear a sword. The workman carried a staff for his own defense. When a man wears a sword he needs a belt. When he wears a belt, with a weight suspended from it, he must strap it too tight for comfort or support it. In these days he is likely to support it on a Sam Brown belt. In earlier times he put two buttons on the back of his coat and placed the belt above the buttons. The sword is gone, and the belt with it, but the buttons remain. They are vestiges.

The dog's foot seems to have four toes. If he were like us, he would have five. A closer examination of his front foot shows a fifth. It is on the inner side, is high off the ground and is loose and weak. It is a mere vestige of what was once a good toe. From his hind foot the fifth toe has disappeared entirely. Every now and then we find a dog, notably many Newfoundland dogs, with

the fifth toe vestigial on the hind foot. Much more rarely we find a prophetic dog with even the vestige gone from the front foot.

We are now prepared to look over the human body and understand certain peculiarities which need explanation.

Why is the body covered with a thin coat of apparently useless hair? Doubtless it is a vestige. Once it served man as clothing. But when he found he could adapt himself to changes of temperature better with a movable coat and used the skins of animals, his hair, no longer needed, began to disappear. In most animals it is heaviest on the back. There it is almost gone from man whose breast is often very hairy. His legs too are abundantly covered if he has much hair anywhere. Man threw a skin about his shoulders, and tied it around the waist. So his legs, his arms, and his breast remained uncovered, and here the hair remained heaviest. Woman covered herself more thoroughly and earlier than man, and she has lost this general coat more thoroughly than he has. In either case it is now a vestige.

It is interesting in this respect to notice that the hair on the forearm slopes rather backwards and towards the elbow. Hair is placed in animals in such a position as to lead rain water off the body without its running back to the roots of the hair. If this principle governed the placing of the hair of the arm, when the hair was useful, the arm was held with the hand up towards the head, as if clasping a support.

Everyone knows someone who can wag his ears. To most of us this accomplishment is lacking, and in truth is one whose want no one mourns. But on dissection, all of us show the muscles, lying against the head and

attached to the ear, which would be used if we wagged our ears. Why do we not move them, when we have the necessary equipment? Our upright position, and the easy turning of the head on the neck, bringing eyes as well as ears into play, have relieved us of the need of turning our ears. Most of us have lost the power to move them. None of us have it in any great degree; but all of us have the muscles, as vestiges of a previously useful equipment.

The human child has two sets of teeth. The first set has twenty in it, the second has thirty-two. All the milk teeth are replaced by permanent ones, and three new grinding teeth are added in each half of each jaw. All three come in early except the last. It comes so late as to be called a wisdom tooth. Not only does it come late, it is uncommonly likely to go early. It is very apt to be more or less deformed, especially about the roots. A dentist friend who takes his own X-ray pictures of his patient's teeth has given me at least a dozen examples, and says he could give me a hundred, in which the last molar tooth in the lower jaw points forward against the tooth in front of it, instead of pointing up. This tooth, as was said, comes late and goes early. Doubtless it will come later and go earlier until finally it does not erupt at all. It will still remain as a bud in the jaw during early life as do the buds of the front teeth in the upper jaw of the cow. The truth is, the human species is getting more brains and less jaw as progress goes on. We have noticed the change in the faces of the series of men we have pictured. The process is still going on, and the third molar tooth is on its way to extinction, though it is still more than a mere vestige.

II

There is a series of occasional difficulties in the human framework which gain significance when looked at in the light of evolution. When man changed his posture, passing from the horizontal to the upright position, he made necessary a considerable series of adjustments of his old body to adapt it to the new position.

The angle of the leg to the human body is so entirely altered, that the muscles about the hip joint must shift completely, if they are to work to advantage. As a result some of them become crowded out. Anatomists have told me that certain muscles which are strong in lower vertebrates are present only as vestiges about the hips of man. These ill-developed muscles are unusually liable to degeneration. Hence when tuberculosis attacks the joints, it is not unlikely to find a weak spot here and to produce hip joint disease, as the result of a not quite complete adaptation to the new position.

When the animal body is held parallel with the ground, all the organs of the abdomen, which are slung like a ruffle, from the back bone, rest easily on the soft abdominal wall. When the position of the body is changed and the backbone is set upright, all these organs tend to bear down and press into the pelvis. In the lower right section of the abdomen the small intestine connects with the large, at right angles. There is quite a portion of the large intestine hanging below the point of union. In the erect position this pouch is jammed against the bony basin of the pelvis. It has thus been turned under and a part of it so compressed as to destroy its usefulness. It is no longer developing like the rest of the intestine but

remains as a more or less useless appendage. Being a reduced structure it is more than commonly subject to degeneration. When this occurs we have appendicitis. This again is due to an incomplete adjustment to the changed position of the body.

Some time since a physician who had been a pupil of mine, and knew my interest in these matters, reminded me that I had once said in class that in time man might entirely lose his appendix. Then he told me he had that day been present at an operation in the hospital on a man who was found to have no appendix attached to his cœcum. I asked him to try to trace through the authorities and the experience of the experts in this operation the frequency of the condition. He was able to find for me three such personal observations of surgeons he knew, and two others he found noted in the literature. Perhaps this difficulty will one day be gone. Operation for appendicitis of course delays the evolution—which is not meant to be an argument against operating.

The same bearing down of the organs makes it more difficult for the blood of the lower part of the body to be pumped back to the heart. Accordingly there is a tendency for it to gorge the blood vessels of the tender portion of the lower bowel, with the very frequent production of annoying tumors in this part of the digestive tract.

The internal organs of reproduction in the human female are uncommonly likely to be affected by this steady bearing down of the contents of the abdomen and consequent pressure on those parts in the pelvis. Just so soon as any lack of muscular tone comes into the female body it is likely to show itself in displacements of these organs, often to the great inconvenience of the owner.

Long as man has been holding the upright position, his body had so tremendously longer a history in an entirely different posture, that it is after all not to be wondered at that the adjustment to what is really a comparatively new condition should not as yet be complete. It is perhaps not without significance that when we come to lie down to rest, we are likely at once to return the legs to their old angle with the body, and thus relax the tension necessary to hold them straight.

III

There is a principle often referred to by biologists by the name of the man who first pointed out the coincidence though he did not interpret it as the evolutionists have since done. It was Karl Ernst Von Baer who showed that in the embryonic life of higher animals there are often stages which bear a resemblance, more or less close, to the adult conditions of animals lower in the scale of life.

Later this idea has developed into the "recapitulation" theory. This supposes that any higher animal, in developing from the egg to the adult, passes through a series of rapid steps which summarize the path by which its ancestors ascended in the evolution of its race. A witty English embryologist has put it "Every animal must climb his own family tree." Put more technically, the life history of the individual (ontogeny) repeats in its main features the history of its race (phylogeny). This law was entirely overworked by the earlier evolutionary embryologists and fell, as a consequence, into perhaps unmerited disrepute. There are so many adjustments of

an embryo to the conditions in which it is placed that it is often difficult to separate ancestral from adaptive characters. And yet there is enough basis in the observations to make a glance at certain points of the human embryo not uninteresting. Most people are more or less familiar with the fact that the young of a frog is a tadpole. It lives in the water, breathes by gills, has a two-chambered heart, swims by the movement of its tail. In all these respects, and many others, it is like a fish. When it has grown up, it will breathe by lungs, have a three-chambered heart and have limbs for locomotion. The young frog then is like a fish. The evolutionist says this is because once its ancestors were fishes and it is recapitulating that stage. A reptile has a similar stage; so does a bird; so does a mammal. The reason we do not realize this generally is because this part of its development is over long before the lizard or the chicken leaves the egg, and before the puppy or colt or child is born.

We are accustomed to think of the human child as beginning its life with birth. Where we speak of a three months' old baby, we mean one whose birth occurred three months previously. Really that child is a year old, and in the first nine months of its life much has happened which, to the evolutionist, looks like recapitulation.

It is only after the first four weeks that the embryo is clearly recognizable, and it is seven weeks old before it looks really like a human being. For the first few weeks of its development, the human embryo has attached to it a yolk sac, such as holds the food for the developing embryo in fish or frog or lizard or chicken. The young of all the higher mammals, until birth, are nourished by absorption from the blood of the mother. Hence

in these there is no yolk in the yolk sac. But the sac itself, though now useless, has not disappeared. This is equally true in all but the lowest mammals. In the very lowest like the duck mole of Australia, the sac is filled with yolk and the embryo absorbs this food into its blood vessels instead of taking its nourishment from the blood of the mother.

At the close of the first two weeks of development, the human embryo has an elongated body, nearly half of it being a long tail behind the point at which the legs are budding. This tail ceases to grow while the rest of the body keeps on. By the end of the eighth week there is only a point where the tail previously lay, and soon the rest of the body grows over this.

During the second and third weeks there are slits in the side of the neck. The artery which runs forward from the heart divides and sends a branch through the ridges between these slits. Later these disappear and with them most of the branches of the artery. One of the slits, however, becomes the canal of the ear. It still runs to the throat as the Eustachian tube, though the opening is covered with a drum and it serves now the purposes of hearing.

All of this the evolutionist believes points to an ancestry for man running far back of the primates and is a recapitulation of a stage once passed when there were no back-boned animals higher than the fishes and these lived in the Devonian Seas.

The brain of all back-boned animals has three great regions known as the fore, mid, and hind-brain. In the mammals the fore brain is comparatively large, but below them the mid brain, or even the hind brain may be as

large or even, in some cases, larger. For about the first six weeks of human development the mid brain is distinctly largest. Then the fore brain begins to get biggest and to develope into the folded and active cerebrum.

Not all recapitulation need be completed before birth or before hatching if the creature comes from an external egg. The robin is a thrush by family. But the robin lacks the spotted breast almost universal in thrushes. This makes it exceedingly interesting to remember that when baby robins come from the nest they have spotted breasts, as their thrush ancestors probably had all through life.

So the human child at birth shows certain peculiarities that seem to have no relation to its needs and which early pass away.

One of our surgeons in a maternity hospital has given us a photograph of an infant which, three weeks after birth, is holding its own weight, hanging by its hands which are grasped about a small stick. This child supported itself for more than two minutes before it released its hold and dropped to the pillow beneath it. I doubt not every young mother is filled with pride at the strength with which her baby can grip her finger.

It is also a matter of common observation that if one's finger is placed against the sole of a baby's foot the toes will curl down and grasp the fingers. The baby also frequently turns the soles of its feet together in a position quite impossible to an older person.

This early tendency of the inturning foot is, however, rarely entirely lost. Enough of us wear the outside of the heels of our shoes faster than the inner side to lead shoemakers to put a short second row of nails on that

side of the heel. When we overturn our ankles nearly always the foot turns inward.

Not one of these features seems significant unless we believe it to be the vestige of an earlier time when man, perhaps not yet entirely human, still lived in the forests of the Pliocene and found his safety and much of his food in the trees.

IV

The question is often asked, and quite naturally, if evolution has produced all this change, why cannot we see its operation now, in the case of modern man? The usual statement is that for the three thousand years covered by the monuments he has remained practically unaltered. It is not entirely begging the question to ask what are three thousand years in such a process. And yet this is not a sufficient answer. The truth is there has been unexpectedly little change. Even so, it is not impossible to suggest a reason why this should be the case.

In the Mesozoic age, the age of reptiles, we find this group of animals adapted to every sort of environment. Some reptiles ran along the ground much as they do to-day. Others, however, with slight front legs and long strong hind legs and tail, leaped as do the kangaroos, though probably more agilely than they. Others flew through the air, on skin stretched between their fingers. Still others, with shortened and flattened limbs paddled through the swamps. Others, elongated and rotund, swam the waters of the seas. Each was adapted to his own particular form of environment. But, in specializing for this type, it had surrendered its power to cope with any other.

When man had evolved a thoughtful brain and a skillful hand he introduced a new method into the world. Now when he wants to fly, he does not convert his arm into a wing. He constructs for himself a flying machine. This he can use when he is flying, and it is better than wings. But the very best part of it is that in gaining this new power he lost no old one. His brain and his hand remain. Indeed, the brain is more fertile and the hand more facile. Then when he wants to swim he builds himself a submarine and swims most effectively. Still his hand and brain remain, but with a larger scope for both. When he wishes to hasten across the land he does not length his legs and feet and drop most of his toes as did the horse. He jumps on the horse's back and makes him carry him. When this speed fails to satisfy him he vaults the tea kettle and beats the horse. When this method proves to be trammelled he seats himself astride a gasoline can and beats the tea kettle. And still his brain and hand are ready for any of the old tasks or for the devising and executing of new.

So there has come to be an extreme stability in man's physical framework. But the evolution is not in abeyance. Now his evolution is that of his implements and of his group. Neanderthal man was loyal to his family. Cro-Magnon had perhaps enlarged his circle. Neolithic man broadened his sympathies so as to embrace his tribe, even to coöperate with other tribes. Bronze man at his best became the dweller in a group covering a wide area.

The group is growing larger constantly. As fast as man's sympathies expand, the size of his group grows. It may now be stuck at a balance of power between allies; but this is surely only a stage. There can be no doubt

that our knowledge of and our sympathies with those of other lands are rapidly evolving. The vision of a world-wide agreement between nations, once the iridescent dream of a seer, is now the hope of a people. In later years it will be the accomplishment of a race.

As we have organs in the human body which are reminiscent of an earlier time, so we have members of the body politic who are not up to the level of their fellows. We have Neanderthal men to-day, so far as respect for the lives and properties of their fellow men are concerned. It is these who make necessary our jails. There are men, who look on all other men as their enemies. They feel it no shame to deceive and take advantage of an enemy, even to the taking of life if need arises. All of us will do this in war. They will still do it in peace. But these are bound to become fewer as time goes on. When we learn to live more nearly up to our knowledge, things will go better.

Not to believe this is not to read the long story of the past. Eddies there are in the current, but the flow of the river is ever onward. Not to believe this is not to see in the working of the world the presence of the Eternal Power whom Jesus taught us to call Father.

CHAPTER XVII

The Religious Difficulty

Man's lowly origin seems a blow to his pride. In reality it is just the reverse. Reverence for a literal interpretation of Genesis holds men back. The newer interpretation. Theology and science. Man created in God's image.

The human mind in any race is undoubtedly inquisitive. Perhaps it is particularly so in the white race and this has led to its rapid advance in science and in invention. Like the Athenians of Paul's day, we like to spend our time either telling or hearing some new thing. Hence, the novelty of the evolution idea makes it interesting and would naturally lead to its rapid spread. There are two very serious obstacles, both natural, one of them creditable. There would be no difficulty if the evolutionists could assure men convincingly that the principle does not apply to man. People do not object to the notion that the dog was once a wolf. The lion and tiger may once both have been alike, and more like the leopard. While this may entertain them as a curious speculation it is a matter of little interest and of no concern.

When Darwin read his memorable paper, coincidently with Wallace's, at the meeting of the Linnæan Society, if he could have shown that, cogent as the theory seemed to

him, there was a clear reason why it could not possibly apply to man, its reception in England would have been far different. It was the consciousness that if this principle be true there is no getting away from its application to the human species which roused the intense opposition. It is this same phase of the question which is now stirring the minds of so many excellent people.

Why then this serious opposition to the idea that man is the descendant, if not of the apes, of a creature so like them generally as only to make it a matter of tremendous relief to some people to realize by how little we escaped that degrading connection. What would be their concern to find, back of the ape cousin, a lemur, an insect-eating, tree-living shrew, a lizard, a salamander, a lung fish, a primitive shark and then we can only guess what. It can be no better than a sea-worm, an infolded colony of lowly animals, and first of all a one-celled animal. This is the dust of the earth with a vengeance. The old pastor called us miserable worms but he did not mean it. We sing of "such a worm as I," but we are singing it only in a Pickwickian sense. When the scientist soberly relates the metaphor, which is meant to be hyperbole, as an actual fact, many of us revolt. It seems to such people degrading to have come from so lowly a stock. As a recent writer suggests, even though we know it to be true (and he concedes it) why make ourselves uncomfortable by thinking about it? He thinks it were better for us to forget the whole miserable story.

This is comforting ourselves by making believe it is not so. This does for children but not for grown-up minds.

But there is a very different attitude which others take,

and which evolutionists are bound to take. There is a side to it by which it becomes a source of pride instead of a source of shame.

We rarely speak with any particular pride of the ancestry of George Washington. We think of him for himself, though as the not unnatural product of two lines of old and aristocratic families. But we mention with great pride the marvelous qualities of Abraham Lincoln and speak of it as all the more marvelous this should be the case, when we consider his exceedingly humble forbears. I think there is a sort of half regret in the minds of many people that some biographers now are tracing the ancestry of Lincoln back to his old English people and finding them of considerable importance. It somehow spoils the Lincoln story in their minds.

If it is added credit to Abraham Lincoln that he should have accomplished so much more than his immediate ancestry, why is it not much more to the credit of man that he should have so utterly outdistanced his competitors who at one time shared with him all his preceding ancestry?

To me the story is one of the most marvelous the mind of man can conceive, that in so humble a strain there should have been such marvelous potency. That under the guiding hand of an indwelling God, whom he can but dimly conceive, it should have been given him to have risen steadily until his advancing body should have been the fit dwelling place for a spark of the Divine Fire. So man had breathed into him the breath of life and became a living soul. The process may always elude our understanding. When, if ever, we do understand it, we shall

doubtless find it as "natural," and as "Divine," as all the rest.

Some day all that story will perhaps be much more clear, and we can then tell it in terms definite and accurate. Meantime the old phrase, dear to men through the ages, still expresses better than any other words he yet has at his command, the incoming of the soul into the human body. We know enough of anatomy and physiology and palæontology to give a more definite picture of how man was made from the dust of the earth. It is not impossible that the day may come when we will know enough of human psychology, of the human mind, the human spirit, the human soul, and in addition the psychology of animals (of all of which we have as yet only a very dim idea) to give an equally definite description to the process by which man became a living spirit.

There is an added phase of this question of man's slow ascent that is still more glorious. Why should we imagine this evolution is ended? Why should we believe we have reached the summit? Surely anyone of us sees points on which he comes short of his own ideal, in body, in mind, in spirit, in social relations, in international sympathies. Why not realize here the future path of evolution? Driven, by a Spirit that groans and travails through all creation, the kingdoms of the earth, both vegetable and animal, have steadily risen to higher and higher levels, without leaving unoccupied the lower ranks. Out of it all has risen a creature capable of recognizing the Power which has made and is making him what he is, and filled with a striving to work towards His likeness. Why should we doubt the continuance of the Power, which is the same yesterday, to-day, and forever? Truly it doth

not yet appear what we shall be. Paul has set before us a glorious goal, that when we really see Him as He is, strife, hatred, envy will be over, we shall be like Him. God speed the day. If we strive really to understand his process, in all reverence I say it, we can help Him speed the day.

Pride, however, has not put so serious an obstacle in the way of men's acceptance of the idea of man's evolution as has religion. To very many men to whom the Bible is dear, though I believe no more dear than it is to many of us who have accepted evolution, the early chapters of Genesis place what seems to them an insuperable obstacle in the way.

They feel as if they were denying God and hardening their hearts against His indwelling, when they give any but an entirely literal interpretation to the Bible account of His work. He took of the dust of the earth, He shaped it into a form like His own, He placed His mouth to its nostrils and breathed of His breath into it. And man became a living soul. To me it seems almost impious to regard this as the actual, literal description of the process by which Infinite Power brought man to pass. As a marvelous picture to teach great truth to the simple mind of an early people it is glorious. And glorious is the work it is yet to do. We all in early life have minds as simple as the Hebrew tribes newly settled in their destined home. To us that story still comes with power. As our mind grows it seems to me one of two things must happen. That story must grow with it; grow in power, grow in significance, grow in interest or it must have its influence on our religious development thwarted. The scientist sees God working to-day in all the occur-

rences of life, and looks with admiration on the marvelous regularity of the operations of Nature which, of course, are the operations of God. Man has read God's thoughts well enough to trust in the return of the light of day, in the growth of the crops with the incoming of spring, to predict the weather with reasonable assurance for days ahead, and with the entire conviction that if he knew all the conditions he could foretell it accurately for years to come. Not only does the astronomer tell us that on such a day there will be an eclipse, but that it will come at such an hour and minute and second. When the eclipse comes four seconds away from his prophecy he does not suspect sun and moon of irregularity or God of changing his mind. He knows that some condition has escaped his notice. If he had known that condition he would not have made the mistake. He tells that the edge of the shadow will fall at just such a street, and that the people of a great city who wish to see it as total will have to go north of that street. What does all this tell us of God? And with this in our minds can we go to that beautiful story and with a literalness that destroys all its power make it tell of a God who makes light and then two days after makes for it a ruler, and makes darkness and gives it too a ruler?

Why can we not believe that in all ages God speaks to the human heart in the language it is prepared to understand? When the Master came to Galilee, he spake to them always in a parable because it was the only language in which they could understand his message.

What is the imperishable truth the Genesis story has given to the world? It is the beginning of a story which has as yet no end nor can it have. It has taught the

world three great truths, beside which all else in it is negligible. It has persuaded us that there is a God. There is a Power over all of which all we see and know is but manifestation and revelation. There is one Power and but one. All else that we call power is power in a lower and more transitory sense; electricity may pass into heat, heat may be dissipated in space, but the Power is eternal. "I am the Lord, thy God," saith Jehovah.

The second great truth as I see it is that He has created and cares for His people. We cannot make ourselves what we will, we must work in accordance with His will, that is, according to what we call Natural Law. His way must be our way or we can get nowhere. And this way is upward. He creates and cares for his people. "God is Love."

Another great truth begins with this story. He demands righteousness of His people. They may think for a while that sheep and goats will do. Sheaves of grain and pigeons may be parted with so devotedly as to make of the denial a real sacrifice. These are only steps to higher truth. In time comes the power of the best of his children to understand Him more closely. "What doth the Lord require of thee but to do justly, to love mercy and to walk humbly with thy God?"

When man has learned these lessons he is ready for the new message, for the Son of God who can teach us of the Father and can assure us that we are His sons.

Perhaps when we have really learned the lesson Jesus taught, and are really ready to work out in our lives the conviction that all men are sons of God, and our brothers, there may come to us another revelation higher than we are yet prepared even to conceive. That revelation may

lead us still nearer to that Divine Power who transcends a universe which light, with all its speed, cannot traverse in thousands, perhaps millions of years.

My faith was stayed by a godly and learned father, humble in science, when my own first difficulties with the story of evolution began to trouble my faith. His teachings were, I believe, God's lamp to my feet and light to my path. He said to me "Theology is man's interpretation of God's revelation of Himself in the Bible. Science is man's interpretation of God's revelation of Himself in Nature."

Each has man's shortness of power and is distorted by his prejudice and his emotion. While man is finite there will always be differences of interpretation. But the eternal God is back of them both and the nearer we get to him the nearer we will be to agreement and to ultimate truth. That time can never fully come to man, but with every step in his growth, either in theology or in science, he will come nearer to its attainment.

Science is man's interpretation of God's revelation of Himself in Nature. Says Agassiz, "Enter into a laboratory as into a sacred place into which nothing profane must enter." The astronomer is stretching out our minds to eons of time and almost terrifying depths of space, filled with stars beside which our sun is as a midge, and bringing us nearer to an understanding of Infinity. The geologist is carrying us back to view in imagination a world under the hand of a Creator, shaping and forming, teeming with a life that advances steadily to higher and higher levels—even though it be a world fifth in size about our sun, which is itself a seventh magnitude star. The zoölogist has opened his mind also to the revelation and

has shown us a world of life strangely linked into unity. Scientists have individually and carefully described and technically named eight hundred thousand species of animals and believe there are as many more still to be discovered and described. All of these, says the biologist, are blood kin each to each. They resemble each other because of that kinship. The nearer the kinship the greater the resemblance. This is the revelation of the kinship of all life. Yet all have developed on one planet, of which there are hundreds larger and smaller, turning about our sun. Is ours the only abode of life? Of course it may be the only abode of life fitted to the earth. But is it the only abode of life? Can it be? Or is the entire universe throbbing with the possibilities of life that develop in each sphere in forms that fit that sphere? Who can say? Who can say no?

The anthropologist is studying that revelation. He is teaching of man. He tells of how, out of the great kinship of life, one strain, with finer and fuller possibilities of developing that life, has slowly risen above all the rest. Man has left his lowly kin with down-turned faces, lifting his own eyes high, and ever higher until now he can see, even though as through a glass darkly, the Person whose personality has a breadth and depth of which ours is but a dim and trembling shadow. It is His great unity which is the unity which binds together all this marvelous manifestation.

"The God that shaped the destiny of man,
And gave its odor to the colored rose
And in the cool eve through the garden goes,
Is the same God that rules Aldebaran."

So the zoölogist is reading the revelation of the eternal uplift of man toward his God. And still man has been on earth but a half million years at most, of the hundred millions, or radiologists say of the billions, of years that ball has been an earth. Oh! the unending greatness of it all. And the still more unending greatness of the Infinite.

And now to turn to the most difficult, the most misunderstood point of the whole question. It has been through thirty centuries (how short centuries seem now) the consolation and support of the children of God that they are made in the image of their maker. They believed that image, scarred with sin as it might be, none the less had a recognizable likeness to their heavenly Father. Must we surrender that sustaining faith? Must it indeed be, as some author terribly asks "God or Gorilla?"

Must we confess ourselves deluded by a symbol in an early parable, yield our comforting trust and humbly and sadly confess our resemblance to our brutal simian kin? No, a thousand times no. We are made in the image of our Maker.

Two great artists have attempted to portray the presence of Almighty God, one in the sixteenth century, the other in the nineteenth. The sixteenth-century artist painted his picture over the altar of the private chapel of the Head of the Roman Catholic Church. The nineteenth-century artist characteristically placed his picture in a most dignified and beautiful library building in America.

The older picture is "The Last Judgment" by Michelangelo in the Sistine chapel of the Vatican in Rome. The newer picture is "Jehovah Confounding the Gods of the

Nations," by John Singer Sargent in the hallway of the Public Library in Boston.

The older picture is one of the greatest of all time; the newer is far from being as great, but it represents the attitude of the modern mind to Almighty God as did Angelo's great picture the mediæval.

The Last Judgment is a tremendous picture in size as well as in subject. Physically, it is the largest fresco ever made. It portrays the wakening of the dead, and the summoning of the living before the great throne. On the left side of the picture the just are lifted by their faith, while on the right the cave of purgatory has yielded its dead. The boatman is driving the damned out of his boat. The whole right of the picture is filled with figures who await in suspense or terror or despair the foreordained sentence. Above the lower center are the trumpeting angels whose summons has awakened all to the knowledge that the final hour is at hand. Above, the angels are treasuring the instruments by which the Christ has wrought his work, the cross and the thorns on the left, and the pillar, symbolic of martyrdom, on the right. Just above the center, forming the focus of the picture, is the Christ God sitting on a throne of cloud, his hand upraised in denunciation, from which even his mother, by his side, shrinks, and before which the unjust cower.

The whole picture is a marvelous conception, nobly executed. To the people of his time, it must have borne a powerful message, preaching forcefully for righteousness. The modern mind understands the crouching terror of the damned, but is not lifted by the contemplation to righteousness. Not all the genius of an Angelo can make

of that athletic figure, with its calm face, a convincing portrait of Almighty God.

In the modern painting the symbolism is not so immediately apparent. Nearly the whole picture is stiff with mysticism and conventionality. Only in the center of the bottom have we any realistically portrayed figures, the naked figures of downcast Israel. In the center a priest with upraised hand supplicates Jehovah to succor his helpless people, bent under the heavy yoke on whose right end is laid the mighty left hand of powerful Assyria. In the right hand of the oppressive figure is a massive sword ready to fall on naked Israel at the first sign of revolt. Backing Assyria is her great Dragon God and his accompanying Lion.

On the left stands the more subtle, but no less dreadful figure of Egypt with upraised mace ready to step in and dominate Israel on the first sign of the withdrawal of Assyria. Backing Egypt is her winged night God.

It seems at first as if Israel were pleading in vain for succor, God is not immediately apparent. Only slowly does the onlooker realize that the glow of the upper middle of the picture is the great Shekinah, the pillar of fire, in which dwells Almighty God, and whose light is the resplendent glow of Jehovah. From the fiery cloud the wings of cherubim, the messengers of God, are hastening. But even this is not all. Out of the right of the cloud comes an arm, bathed in light, stronger than the strong arm of Assyria, which it grasps. The might of Assyria is stayed by the greater might of Jehovah. Out of the left of the cloud comes a lithe and subtle hand, also bathed in light, resting on the arm of Egypt. The subtlety of Egypt is thwarted by the greater subtlety of

Jehovah. But Jehovah himself does not appear. Man may not look on the face of Almighty God and live; so said the prophet of old.

We are made in the image of our God. But that image does not consist of eyes, of mouth, and feet and hands. Does a God who pervades all space see with eyes? Does a God who speaks to the heart of his chosen speak with a mouth? Does a God who is nearer to us than breathing, approach us on feet? Does a God who lifts the spirit of those who earnestly seek Him draw us up with hands?

No; our hands and feet we share with humbler cousins, our eyes and mouths with other kin, humbler still. These are not the image of God. That lies deeper far. When we turn in love to a brother who has been broken by sickness or want or shame and share with him our strength, our vigor, our standing in the community, we reach out with hands like the hands of God.

When we see the longing in eyes that look up into ours, longing for justice, for recompense of effort, for love, and our heart goes out to satisfy that longing we are looking through eyes that are like the eyes of God.

When reviled, we revile not again; rebuked unjustly, we turn not away in wrath; misunderstood, we sink not into ourselves but bravely go on giving the message that God has put into our hearts, we are speaking out of a mouth like the mouth of God.

Love for the brother, willingness to spend and be spent in the service of others, striving that justice and righteousness prevail in the land, these are the image of God in us and not our hands or our feet, not our eyes or our mouth.

INDEX

#Indicates an Illustration.